

A N  
EXAMINATION  
OF THE  
REFLECTIONS  
ON

*The Theory of the Earth.*

Together with  
A DEFENCE of the REMARKS  
ON  
Mr. Whiston's *New Theory.*

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*The Theory of the Earth.*

THE Defence of the Theory which has been lately Published in Answer to my Examination of it, is styl'd *Reflections on the Theory of the Earth*; But if its Author had observ'd the Title, and made more Reflections on the Theory, tho' fewer on the Examiner, he had acted more like a true Philosopher, and perhaps might have saved himself the labour of Publishing any thing more than an ingenuous acknowledgement of its errors, and me the trouble of a Reply. But since the Reflector has been pleas'd to follow another course, I must take his work, and consider it in the method it lyes.

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He

*An Examination of the Reflections*

He first sets down three propositions which He calls the foundation of the whole work, "*viz.* That the Primitive or Antediluvian Earth was of a different form from the present. 2<sup>dly</sup>. That the face of the Earth as it rose from a *Chaos*, was smooth, regular, and uniform, without Mountains and Rocks, and without an open Sea. 3<sup>dly</sup>. That the disruption of the Abyss or the dissolution of the Primeval Earth was the cause of the Universal Deluge. To these he adds a Corollary drawn from the primary propositions concerning the position of the Earth; in which he says, that the posture of the Antediluvian Earth or its Axis, was not oblique TO THE AXIS OF THE SUN or of the Ecliptick as it is now; BUT LAY PARALLEL TO THE AXIS OF THE SUN, and perpendicular to the plane of the Ecliptick." These he makes the onely fundamental propositions of the Theory, (tho' the Theorist in his ninth Chapter Book 2<sup>d</sup>. makes one more concerning the oval figure of the Earth) and tells us, "That he who will attack it to the purpose, must throw down in the first place these leading propositions, and that if the

" Examiner

“Examiner had taken this method, and  
“confuted the proofs that are brought  
“in confirmation of each of them, he  
“needed have done no more; but if in-  
“stead of this, a loose stone be onely  
“picked out here and there, or a Pin-  
“nacle struck off, it will not weaken the  
“foundation.

I cannot imagine how this Author can assert, that I have not followed this method in refuting the Theory; for if these he has mentioned be the substantial and vital parts, I have examined every one of them, as will plainly appear to any one, who will read the Examination; so that what he has said of me in another case, may be very well apply'd to himself, *That either he never read over, or does not remember, or which is still worse, does willfully misrepresent what I have written on this subject.*

The design of the first Chapter of the Examination is not as this *Defender* imagines: to prove that the Deluge might have been made by a miracle, but to answer the general Argument which the *Theorist* with a boldness little becoming a Divine, brought for the truth of his Theory, viz. \* that it could be made no other way, and therefore his

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method

\* *English*  
*Theory Ch.*  
*7. Book I.*

method being the onely way *possible*, was the real one. To this I answered, that I thought it possible the Deluge might come by a miracle, and that God Almighty was the immediate cause thereof, the Scriptures having given us such an account of it in these emphatical terms, (Gen. 6. 17.) *Behold saith God, I even I do bring a flood of waters upon the Earth.*

But the *Defender* is displeased because I did not tell him wherein this miracle consisted. The truth is, I never thought it my business to explain miracles; and I wish no *Theorists* or Philosophers had set up for it. I should be well contented to find in their writings a Mechanical and easy account of the common and ordinary Phœnomena of nature. But it seems this Author will not be satisfy'd unless I tell him how the increase of waters at the time of the Deluge was made on the Earth. I answer, that according to the Scripture, some of the water was rais'd from the great deep, and sustain'd on the surface of the Earth by the hand of Omnipotence, a great part of it descended by fourty days continual rain; the waters which occasion'd this rain being either newly created, or risen from other matter turned into that Element,

Element, or brought from some other place best known to the Divine Omniscience: which of all these three methods was used, I will not take upon me to determine; but I think it might have been done by any of them, notwithstanding the reasons alledg'd in the second and third Chapters of the Theory, which this Author thinks me oblig'd to answer. It seems he thinks them very strong and convincing, tho' when I wrote the Examination, I thought them so weak and precarious that it would not be worth while to take notice of them. \* The \* *English*  
arguments against a Creation of waters *Theory Ch.*  
are founded on a notoriously false no- *3. Book I.*  
tion of the *Cartesian* Philosophy, viz. That matter and space are the same: according to which principle 'tis not easy to understand, how either Creation or Annihilation can be possible. Nor do I think the arguments against Transmutation of Air or other bodies into water, of greater force than the former: For if all bodies be onely different in their modifications, motions and figures, I can see no reason why any body may not be changed, and put on the form of another; and therefore, if according to the Theorists principle there is no vacuity

in Nature, not onely the Air may be changed into Water, but also all the subtil matter which fills its Pores; and according to this principle of a Plenum, that subtil matter will make as much Water as if the same bulk of absolutely solid matter were transformed.

The *Defender* alledges, that if I proceed upon such Waters as were already in being, and make them either Supercelestial or Subterraneous, I must tell him WHAT THESE WATERS ARE, and must answer such objections as are brought against either sort in the second and third Chapters of the Theory; if he means that I should tell him the nature of this Water, and of what sort it was, I answer, that it might be common Water, for that will be sufficient to drown the World; but if He designs that I should tell him from what place it was brought, and how it came there, I must own I know not: For to answer the question which he makes in another place, I have not yet been all over the Universe to make Observations, nor have I had any Revelation made me; it is enough both for him and me to suppose this Water like common Water, and that 'twas brought upon the Earth by the Power of God. The  
argu-

arguments which the *Theorist* brings against the possibility of any such Waters, are sufficiently answered in the 30th. and 31st. Pages of the Examination.

After this, the *Defender* passes to the second Chapter of the Examination, where I find he has but little to say to the arguments, tho' he would fain have them appear small and trivial. I affirm in that Chapter that most of those bodies which compos'd the outward Crust of the Earth were heavier than Water, and by consequence must descend both through the Oil and Water also; and that tho' small grains of dust, specifically heavier than Oil, if thrown upon it would not descend because of its tenacity, yet if the weight of these particles chanced to be increased by the additions of more, they must fall down. To this He makes answer, that the parts which formed the Crust were not *huge lumps of solid matter*, but little tenuious particles or small dust. Did not I make the same supposition, and yet show'd that tho' these small particles of dust when they first fell, might have been sustain'd by the Oil, yet when their bulk came to be increased by the falling of a great many others, their weight would be aug-

mented proportionally; upon which account they must descend like other huge lumps of solid matter, and that long before ever they could form a solid Crust, that would be necessary to support the weight of all the rest of the descending particles? But the *Defender* has wisely passed over this part of the argument, knowing it would be a hard matter to answer it.

I wish the Theorist or his Defender would be so kind as to give us a specimen of this Operation for the making of an Earth, and because it wou'd be too hard a task to make a whole One, I would desire them to make a small portion of One; let them take a Vessel, in which let some Water be pour'd in, and after that some Oil, and I would have them try if by throwing on the Oil, small grains of Sand, Gravel, Clay, Stone, and other Materials heavier than Water, they can form a Crust: and we shall begin to think the rest of their Theory possible, if this Experiment succeeds.

I had another Objection against such a formation of the Crust, upon the consideration of the great height, from which these particles would fall, by which their force and celerity must be very much increased,



creased, and therefore of necessity they must pierce the oily liquid, and break thro' to the bottom; this the *Defender* allows of, providing these particles descended like stones or any other ponderous bodies; but He affirms these particles descended not in that manner, but rather like flakes of Snow hovering and playing in the Air, their course being often interrupted and diverted, and their force broken before they arriv'd at the end of their journey. To this I answer, that tho' these particles were small, yet they were ponderous, being of the same intrinsick gravity with the matter of which the outward Crust of the Earth is made up, and upon that account we cannot suppose them to be like flakes of Snow, whose weight is but small, and their surfaces very large in proportion to their bulk, which therefore must suffer a far greater resistance than we can suppose these descending particles to have done. Besides, if we consider the great height from whence these particles fell, which the *Theorist* affirms to be as high as the Moon; and the thinness of the Air at such a height (which must be extremely pure when Mr. *Newton* calculates that now at a Semidiameters distance

stance from the Earth ; the Air is so rare, that one inch of our common Air near the surface, if so much expanded as that is, would fill a sphere as large as that of *Saturn*) we must of necessity think, that the descending particles would not meet with so great a resistance as the Defender imagines. For whatever interruption or diversion they met with from the Air in their descent, would be inconsiderable. But the greatest part of it would arise from their falling on other particles which were also descending, tho' not so fast, by which, tho' the velocity of the swiftest body would be diminished, yet according to the Laws of motion, the momentum or quantity of motion of both bodies taken together would remain the same, and by consequence their force upon the oily Orb would be also the same. I know no way the *Theorist* can take to answer these objections, but by supposing that the Creation was neither in Spring, Summer nor Autumn, as is commonly supposed; but that it was in the Winter when both the watry and oily Orbs were frozen, and had consistence enough to sustain these particles till they were formed into a solid Arch, able to sustain it self;

self; and if he will embrace such an opinion, I shall not take the trouble of refuting it, having so many others of the same weight upon my hands. The Reader may observe, that He takes not the least notice of the argument I brought against him from Scripture, to prove that there were Mettals in the primitive Earth, which he plainly denies.

After these things this Author comes to quarrel with me for making insinuations and suggestions, as if the *Theorist* did not own the hand of a particular and extraordinary providence in the formation of the Earth. I own I did make such insinuations, and I leave the Reader to judge whether I had not reason to make them. He has openly rejected the History of the formation of the Earth as deliver'd by *Moses*, and has deduced it purely from natural causes, and the necessary Laws of Mechanism. Now if the matter of the Earth from a *Chaotick* state did of necessity form and settle it self into a habitable Earth, from the sole necessary principles of Mechanism and Gravitation, as the *Theorist* has deduced it; I would fain know how this opinion differs from the *Epicurean*, which the *Theorist* so deservedly derides? I know

know the *Theorist* talks very much of Providence both ordinary and extraordinary, and makes most excellent Discourses against the *Epicureans* for denying of it, which I was so far from not reading or forgetting, or even willfully misrepresenting, that I transcrib'd some of them in the Examination, as an argument against his own Theory.

It is a common thing with Theorists and Philosophers, who are great Politicians in their way, to disown any opinion which they think will bring upon them the displeasure of any considerable part of Mankind, tho' it follows plainly from their Principles; or if that cannot be done, they hide and colour it the best way they can, that it may not appear too open and plain. Thus the *Theorist* protests, that he meant no harm, when he affirm'd the History of the Creation as it was deliver'd by *Moses*, to be fabulous, and ridicul'd the Scriptural relation of the Fall; and I have really the charity to believe him; yet hereby he has set the *Atheists* and *Theists* in a method of attacking our Religion, and given them Schemes by which they think they can defend their own Principles.

After this the *Defender* passes to consider

sider what is said in the third Chapter of the Examination about Mountains; He owns it to be a subject that deserves consideration, and He says, that if the Examiner can prove that there were Mountains in the primitive Earth, He will undertake that the *Theorist* shall make no further defence of his Theory. The *Theorist's* great argument why the face of the primitive Earth was smooth and without Mountains, depended on the supposition that the *Chaos* from whence it took its original, was perfectly a fluid Mass. This I affirm'd to be a precarious Hypothesis without any foundation in nature, since the greatest part of the bodies we have in the Earth, are hard and solid, and there not being a quantity of Water in Nature, sufficient enough to moisten and liquify them, the *Chaos* could not be so fluid as 'twas necessary it should be, to form it self into an uniform smooth body. Besides that, the greatest part of them, such as Stones and Mettals, are incapable of being liquify'd by water. The Defender's reply to this is, *Very good, what is this to the Theory? Does the Theorist any where affirm that there were Stones or Mettals in the Chaos, or that they were liquify'd by*  
*Water?*

*Water?* The Theorist owns no such doctrine or supposition. I hope the Defender will not think this any answer to the objection; I am sure none of his Readers can. I thought that it concern'd the Theorist very much, to prove his *Chaos* to be a fluid Mass of matter; for otherwise it is not necessary that it should have its surface smooth, regular and uniform; at least it is fitting that the objections against its fluidity should be answer'd. For if the Examiner can prove that the *Chaos* was not altogether so fluid as the Theorist imagines, and from thence shew, that there was no necessity that the face of the Earth should be smooth and without Mountains, then the *Theorist's* argument must be of little force, and that objection will still very much weaken the truth of the Theory.

I freely own indeed, that the World was produced from a *Chaos*, such a one namely as is recorded to us in Scripture; but I am far from granting that the Theorist's notion is any ways agreeable to it, he supposes that all the Elements Air, Water and Earth, with all the principles of Terrestrial Bodies were reduc'd into one fluid Mass, and mingled with one another, so that the parts of any one

one sort could not be discern'd as distinct from the rest. This I suppose is a new sort of *Chaos* which never existed any where but in fancy.

It were easie for me here to assume the Defenders method, and argue against it, by putting him questions, how, when and where, was this mixing and blending together of all the Materials of Heaven and Earth? By whom, upon what design, and for what purpose was this done? Was it to the end that they might all settle themselves again in order, and each take its place, according to its specifick gravity; but if the great parts of the World were for the most part so before, what necessity was there for disturbing them, only that they might range themselves orderly again. He would do well also to tell us, from whence he had this account of the *Chaos*, from Sacred or Profane Writers, if from the latter, we are to value their authority no further than they are agreeable to the Scriptures, since it would be no hard task to prove, that it was from the Sacred History that the Heathen Writers first drew their knowledge of the *Chaos*, which they afterwards corrupted with their own fancies. In the Holy Scriptures I can find no account

count of the mixing and reducing of all the Materials of the World into one fluid Mass. *Moses* indeed tells us, that the Earth was *Tohu* and *Bohu*, which we render without Form and Void, and can we from thence conclude, that all the parts of it were fluid and mixed together? We may allow, that the *Jews* understood the sense of these words better than we, or any Heathen Writers, and they give them a contrary meaning; for according to the *Syriack* Translation, those words signifie, that the Earth was without either Habitation or Cultivation, *Terra erat deserta & inculta*; in the *Chaldaick* Paraphrase they signifie, *deserta & vacua*. The *Targum* of *Jonathan B. Uziel*, supposes their meaning to be this, *Terra autem erat stupor & inanitas, vasta à filiis hominum & vacua ab omni jumento*; with which the *Jerusalem Targum* does well agree, according to which Paraphrase they signifie, that the Earth was *stupor & inanitas & desolatio à filiis hominum, & omni bestia vacua*, as that Paraphrase is render'd in Latin. We may conclude from thence therefore, that the *Jews* thought that all that was mean't by the words *Tohu* and *Bohu* was, that the Earth was Void and Uncultivated, without



out Ornaments and Inhabitants, Men or Beasts, or any sort of Animals.

Nor was the opinion of the ancient Christian Fathers any wise different from that of the *Jews* as to this matter, *Tertullian* in his book against *Hermogenes* says, *Unde compertus es Hermogenes uniformem & inconditam illam fuisse materiam quæ ut invisibilis latebat*; and in the 30th. Chapter he plainly proves from Scripture, that there was not a confus'd heap of matter mixed and blended together, out of which all things were made. St. *Ambrose* in the 8th. Chapter of his *Hexameron* says, that the Earth was *incomposita utpote solertis agricolæ inarata culturis, quia adhuc deerat cultor*, and again, *Terra erat incomposita quia nuda gignentium, nec thoris herbosa riparum, nec opaca nemoribus, nec leta segetibus, nec umbrosa superciliis montium, nec odora floribus, nec grata vinetis*. St. *Basil* tells us, that the true beauty and composition of the Earth arises from its great fertility, whereby it is productive of all sorts of Vegetables, such as Plants of all kinds, lofty and tall Trees,

παροπαῖν βλαψήσας, διδραμὴν ὑψηλοτέρων σφ. πωλαί, καρπύμην τε κ. σφρα-  
γαν. αἰών α' χρυσία ε' δολαρία, εἰς. ὡς ἐπειδὴ ἐπὶ ἡμῶν ἡν. ἀκατακτά-  
σας ἀνὰ τὸ ἐλογ. ἐκέρως ἀνόμενοι. In his 2d. Homily in *Hexam.*  
near the beginning.

as well those that bear Fruit as those that afford us none, fragrant and sweet Flowers differing both in colour and smell; and the Earth says he, being naked and unfurnished with any of those sorts of Ornaments, might well be said by the Scriptures, to be Void and without Form.

In those discourses of the ancient *Jews* and primitive Fathers, there is not one word of a perfectly fluid Mass of matter out of which all things were made, there is nothing there of the mixing and blending together of the Elements, and all the Materials of Heaven and Earth; in their Writings we cannot see that such a *Chaos* as the *Theorists* fancies, was ever either deliver'd or suppos'd: we find that their notion about the origination of the World was very different from the *Theorists*, whose Hypothesis is not therefore founded on any authority which is sufficient to induce us to believe it.

Nor has his opinion any more foundation in reason than authority, for if we should allow of the *Theorists* account of the Waters that are in the Earth, and from thence by computation compare the solid bodies with those that are fluid, we shall find, that the liquids are not the hundred thousandth part of the solid  
bodies

bodies in the Earth; nay, if we should take in the Atmosphere, the whole System of fluids will not amount to the thousandth part of the solid bodies: from which it plainly appears, that the *Chaos* cannot be thought to have been in any manner an intirely fluid Mass, but rather a hard and solid one. For if we take hard bodies as Earth or Clay, and fluid as Water or Oyl, and mix them together in the proportion of eight thousand to one, or even in that of a thousand to one; that is, take one inch of fluid matter for a thousand inches of solid matter, the fluids will have but a very small effect on the solids. Since therefore the whole composition of the *Chaos*, when all its parts were mixed and blended together, must not have been fluid, but rather hard and solid; I hope the *Defender* will allow the objection to be to the purpose; and of force against the Theory, which is founded on a contrary supposition.

Having thus prov'd that the far greatest part of those bodies which compos'd the *Chaos*, were firm and solid, I think it easie to shew, why there is no necessity that an Earth form'd from such a composition, should be smooth and regular;

for it is not so with solids as with fluids, where all range themselves according to their intensive gravities, and settle themselves into a regular and even surface; whereas solids take their place according to the order they happen to be in, that body coming soonest to its rest, which is nearest the Centre, without any respect had to gravity or levity, and where these bodies happen'd to be thickest or highest, or their parts less coherent, there also after their fall would their surfaces be highest, and the face of the whole would be very rugged and mountainous; the liquids, if we should allow them to separate from the solids, would descend and fill the Holes, Cavities, and Caverns that were made by the falling of these irregular peices on one another, and what was more than sufficient for this, might spread its self upon the Valleys, and leave great protuberances of the solid Mass, as great as any of our Mountains standing out above the surface of the Water.

But granting, that the greatest part of the *Chaos* was a fluid Mass, I brought another argument in the Examination to shew, how the face of the Earth might be mountainous and uneven, by  
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supposing in the *Chaos* a great many bodies; which, by being in a great measure hollow, or fastned to some other matter of less gravity than that of the fluid *Chaos*, would swim on the surface of it, after the subsiding of all the rest, and some parts of them standing above the surface of the watery Orb, would form Mountains. The *Defender* answers this, as he does most other objections, by a question, *Who told me that these lumps of matter were hollow? Is not this precarious, or rather Chimerical and ridiculous?* I answer, I came to know this after the same manner, that the Theorist knew there were neither Mountains nor Seas in the Primitive Earth; if it be a precarious Hypothesis I cannot help it, but it is my comfort, that if every thing that's precarious be also Chimerical and ridiculous, I know whole Theories that will be so likewise.

After this he falls into a strain of very learned questions, What made those solid lumps hollow, when, or where, or how were their inward parts scooped out of them? I know none but *Theorists* that can give a positive answer to such nice questions; I am content to say, they might have been so order'd by God Almighty

mighty at first, for that very end that they might swim on the Abyfs: tho' another *Theorist* says, that the fluid Abyfs was much denser and heavier than the Mountains, and therefore they could not sink: and it is indifferent to me which of these answers he takes, or if he find out some other of his own, which he can easily do if he has a mind to it, that he will like better. It is enough for me to shew, that there is no necessity that an Earth arising from a *Chaos*, should have its surface smooth and uniform, as the *Theorist* pretends it must.

But this *Defender* thinks that it is my opinion, that Mountains were really form'd after this manner, and from thence he proceeds to collect, from my Principles and Concessions, that there could be no Sea in the Primitive Earth, and that an Orb of Earth must have been built over the Abyfs, and after all he concludes, that I have no good hand in making Mountains.

This way of writing would almost tempt me to believe, that he had never read over that Chapter which he pretends to answer; for by the reading of it, one may plainly see that it was not my design to settle this, or any other  
new

new Theory of my own, about the formation of Mountains; nay, I positively declar'd, that I thought *there were other principles concurring to the formation of Mountains, besides gravitation and the known laws of motion*: my business was onely to shew the weakness of the Theorist's arguments, and that an Earth arising from a *Chaos*, might have been uneven, rugged, and mountainous, notwithstanding he asserted, that it must necessarily form its self into a smooth, regular, and uniform Figure. For my part, I think it absolutely indifferent to the question, what way Mountains were made at the beginning of the World, whether by Mechanical causes, or by the immediate hand of God Almighty, or if by hollowing and making a channel for the Sea, the Earth was rais'd and laid upon the dry land to form Mountains; (which by the by, is not so ridiculous or so repugnant to Calculation, as the *Theorist* imagines) it was sufficient to my purpose to shew, that there was no necessity that the face of the Primitive Earth should be without Mountains.

Having thus laid open the weakness of the *Theorists* arguments, I endeavoured in the next place to shew, the great

great use and advantage that Mountains afforded to mankind: The *Theorist* asserted, that they did not consist of any proportion of parts, that is referable to any design, or which had the least footsteps of Art or Counsel. This I thought was a bold and ill grounded assertion, since it is certain, that they are so far from being placed upon the Earth without any design or contrivance, that they are justly reckon'd by the Philosophers, amongst the most useful, as well as the most stupendous parts of nature; without them we could have had no Rivers or Springs, which are things necessary to us, not only for our Commodious living, but for our very subsistence. One would think that this consideration was a sufficient argument to make us believe that Mountains were not great Ruins, or the rubbish of a broken World; but that they had been placed upon the Earth at the Creation, with a design that they might serve the Antediluvian World, with the same advantages and uses they afford us in the present One. For it is certain, that they had Rivers and Springs as well as we, which they could not have in a smooth Earth, where there were no Mountains; in which, Rivers  
vers



vers were to have their origine, no upper and higher grounds from which the water was to descend on the face of the Earth.

Instead of answering the argument, He makes a long declamation against me for asserting that it is impossible to live without Rocks and Mountains. He accuses me for confining the Divine Omnipotence and Omniscience, to one single mode or fabrick of a World, and of thinking all the Planets cast in the same mould: Who (says he) ever observ'd Mountains and Rocks in *Jupiter*, or in the remains of *Saturn*? I answer, who but those that have observ'd Men or other Animals there, that must have Water and Rivers, as things necessary for their sustenance?

Tho' the *Defender* is very Eloquent and Witty on this Subject, quotes *Virgil* and *Cicero*, and complains much of the narrowness of some Mens Souls, yet I think I can make it appear, that this assertion, as I deliver'd it, was no limitation of either the Divine Omniscience or Omnipotence. None ever doubted but that God Almighty could make Men subsist without Mountains, Rivers, Water, Meat, or any other sustenance; but

but yet, one may boldly say without confining the Divine Power, that it is naturally impossible for such Creatures as we are, to live without those things; for our Natures and Constitutions require them; and he must be without doubt in a preternatural state that can live without them. The subject I was then handling was in Natural Philosophy, where we are not so much to consider what is absolutely possible or impossible for God Almighty to perform, as what is agreeable or contrary to the establish'd Laws and Rules of Nature. Thus it is naturally impossible that Men or other Animals of such Constitutions as we have, can live without fresh Water, Rivers and Springs; it is contrary to the natural order of things, that these should be without Mountains and Rocks, Upper and Lower grounds, for Water cannot naturally run upon an Horizontal Plain; and therefore we may rightly conclude, that where there are Men, there must be Mountains and Rivers, Upper and Lower grounds, and all other things necessary for life.

It is absolutely indifferent to me, what sort of mould the rest of the Planets are cast in, or what Inhabitants there are in  
*Jupiter,*

*Jupiter, Saturn, or Mercury*, or if there are any in either of them, (which I am sure is more than he can prove) yet I would think it no hard matter to shew, that it is impossible for us Men, or other Animals of the same Nature and Constitution that we have, to subsist in either of these places. For *Saturn* being very near ten times further from the Sun than we, must have a hundred times less of his influence; and the distance of *Mercury* from the Sun, being but one third part of our distance, the heat of the Sun upon that Planet must be nine times greater than it is upon ours, (the action of the Sun upon any subject being always reciprocal to the square of its distance) both which extreams are by far too great to be endur'd by Creatures of our texture and frame of parts; and therefore we may rightly conclude, that whether they be mountainous and rocky, or have their surfaces smooth and even, yet it is impossible that they should be Habitable by us, or Creatures of our Constitution; tho' yet we know not but there may be some sort of Inhabitants in these Planets, whose frame and temper will suit with the nature and position of their respective dwellings. Thus  
we

we generally account the places that are near either of the Poles uninhabitable, because no Men can dwell there; tho' it is certain, that Bears, and several other Animals, whose natures agree best with such a Climate, live in these places; and perhaps, if ever the *Theorist's* Earth had existed out of his own imagination, it might have been furnished with some sort of Inhabitants, tho' it had been naturally impossible for men to have subsisted there.

'Tis somewhat hard that a Man cannot dissent from the *Theorist* and his opinions, without being taxed for narrowness of Spirit. But whatever the *Defender* may imagine, I am sure, there are some who esteem it as a sign of a weak and narrow Spirit, to believe easily any Hypothesis, without sufficient evidence of its being true; which cannot be produced by the *Theorist* in this point. For my part, I think *Virgil's* Shepherd, whom the *Defender* laughs at for not letting his imagination rove, to fancy things he had never either heard or seen, much wiser than some *Theorists*, *Philosophers*, and *Free-thinkers*, who take the liberty to imagine and believe any thing, but that to which in all reason they ought to give a firm assent. After

After a long declamation againſt confining the varieties of Providence to a narrow compaſs, (which I know none that do) the *Defender* aſſerts, that my arguments run upon impoſſibilities; which he ſays is a nice Topick, that lies much out of our reach; and he thinks, that there may be Rivers without Mountains, notwithstanding my reaſons. All that I can ſay to this is, that if he will not be convinced by reaſons, which he cannot or does not pretend to answer, he may think as he pleaſes; but I hope he will allow me the freedom to diſſent from him, till thoſe arguments be answer'd.

THE design of the 4<sup>th</sup>. Chapter, was to ſhew the inconveniences that would fall upon the Earth, in caſe it had ſuch a poſture as the *Theoriſt* aſſign'd the Antediluvian World, namely, an Axis perpendicular to the plane of its Orbit. To this Chapter the *Defender* makes ſome general answers; but firſt, according to his uſual cuſtom puts a queſtion, viz. If I will vouch that there are no habitable Planets in the Univerſe that have ſuch a poſture? *Jupiter* he ſays, is known to have a perpetual Equinox, and his Axis parallel to the Axis of the Ecliptick; here he is miſtaken, for it is not parallel  
to

to the Axis of the *Ecliptick*, but that of its own Orbit; *Mars* says he, *has little or no obliquity, and must we suppose that these Planets have no Inhabitants, or that their habitations are very bad and incommodious? Jupiter is the noblest Planet in the Heavens, whether we consider its magnitude, or the number of its attendants; and if a Planet of that order and dignity have such a position to the Sun, why might not our Earth have had the same? What is all this to the purpose? Are the Inhabitants of Jupiter the same with the Inhabitants of our Earth? Or how does he know that there are any at all there? It seems this Gentleman is mighty in love with Jupiter and its Inhabitants; what degree of nobility and dignity it has obtain'd I know not, yet if he was in the most pleasant country house in all Jupiter, so far I dare vouch, that he would not be pleas'd with his habitation, but would desire to change and come down again to his old Rocky Mountainous Planet the Earth, and rather than stay there, he would be contented to live in Lapland.*

I make no question, but that the present position of *Jupiter* is very fit and well suited to the nature and temper of its Inhabitants, Plants, and Vegetables,  
(if

(if there be any there) but what is fitting and commodious for them, may be very inconvenient for us; if we were in *Jupiter*, our blood perhaps would stagnate and freeze, and a Jovian if he were brought hither, would melt with heat. The inconveniencies I shew'd, would arise from a perpendicular position of the Earths Axis to its Orbit, were only in respect of the Inhabitants of the Earth, and did not in the least concern those of *Jupiter* or *Mars*, to whom such a posture might be more convenient than any other. *Conveniencies* and *inconveniencies* are relative terms, and therefore to prove a position incommodious, we must not only consider the consequences of the position its self, but the Nature and Constitution of those Animals to which it is to be adapted; and I hope I may affirm (without any reflection on Divine Providence) that the present position in which God hath put the Earth, is more suitable and agreeable to the Nature and Frame of our Animals and Plants, than any other, and especially than that which the *Theorist* assigns to the Primitive Earth: I am sure that several Divines have asserted this, and were never thought by such an assertion, to pre-  
scribe

scribe to God Almighty what was best to be done.

I censur'd the *Theorist* indeed for inquiring into Physical causes, when there are none that can be known, and neglecting the final ones, which were the only real principles by which the question was to be determin'd. For as I shew'd in the Examination, there is no reason that can be assign'd why the Axis of the Earth should have one position more than another; the two motions of the Earth round the Sun, and round its own Axis, being perfectly independent on one another. God Almighty would order that which was most fitting and convenient for its Inhabitants; and I lay'd it down as an Axiom, that God Almighty did always choose such positions as brought with them the greatest good and advantage to the Universe; and therefore, since the oblique posture of the Earths Axis was that which its Maker was pleas'd to choose, I thought it might be undoubtedly presum'd, that it was the best. Proceeding on this principle, I inquir'd into the several advantages which we reaped by the present oblique position, and shew'd, that it was preferable to any other; and surely this cannot



not be (as the *Defender* thinks) a pre-  
scribing to God Almighty, and telling  
him what is best to be done in this or  
that World. When from the Wisdom  
and contrivance of what is already done,  
we argue that it could not have been  
done in a better manner.

He goes on and says, "That some men  
"cry out mightily against reason; and yet  
"none are more fond of it than they, when  
"they can get it on their side. Some men  
"inveigh against Physical causes, when  
"others use them, and yet as gladly as any  
"make use of them, when they can make  
"them serve their purpose; and when  
"they cannot reach them, they despise  
"them, and are all for final causes. I never  
knew any that cry'd down either reason  
or Physical causes, when they were plain  
and obvious. But it is no wonder if  
there are some that are displeased with  
the reasons and causes that are assign'd,  
by a set of Philosophers who think they  
can give a Mechanical account, how an  
Animal, a Mountain, a Planet, or a World  
may be made; and yet they know not  
so much of the principles of Staticks and  
Geometry, as to explain the most com-  
mon and ordinary appearances of nature,  
which are really explicable by Mechan-  
ical principles. C And

And tho' one would think that it were but reasonable, that a man who pretends to give the Physical causes of all those things, should be very well skill'd in Arithmetick, Geometry, Mechanicks, and the Laws of motion; yet it generally happens, that those that are least acquainted with those Sciences, pretend most to the solution of such intricate problems, whereas they, who know them best, can best discover how far they may proceed upon Physical causes, how far their principles will lead them in the discovery of truth, and where it is that they must be content to be ignorant; they know that they have not sufficient *Data* to determine such problems, nor a great many others that have not the hundredth part of the difficulty of those I have mentioned; and they are well pleas'd if they know their final causes, the uses for which they were design'd by their wise Contriver, and never trouble themselves with that which it is impossible to discover.

Monfieur *Hugens* I think, was at least as great a Philosopher as the *Theorist*, and it may be easily suppos'd, that he understood Mechanism somewhat better; yet he says, that he would be contented, and should

should think, that he had done a great matter if he could come to the knowledge of things as they are now, never troubling himself about their beginning, or how they were made, knowing that to be out of the reach of humane knowledge, or even conjecture \*.

\* *Hugenii  
Cosmotheo-  
ros.*

This Author it seems is very angry with me, for denying, that the Primitive Earth had such a position as the *Theorist* assign'd it; and upon that account he says, I follow the very doctrine of those Scoffers mention'd by St. *Peter*, who said, *Since the Fathers fell asleep, all things continue as they were.* Why so? Did these Scoffers assert, that the Earth had never any perpendicular position to the Plane of the Ecliptick? and did St. *Peter* affirm the contrary? Did he say that the old World had a perpetual Equinox, the Equator being coincident with the Ecliptick, and its Axis parallel to the Axis of the Sun, as this Gentleman phrases it? I can find no such discourse in either of his Epistles, nor can I see how such a thing can be deduced from them.

A man that had no Theory, or any particular System of his own to defend, would think this the plain meaning of St. *Peter*, that there were some men then

in being, that deny'd a Providence, or that God Almighty had any care in the Government of the World, because they thought, that since its Creation, every thing went on still in the same method, without any particular manifestation of a Providence; these the Apostle refutes, by telling them, that the World once perished by a Deluge of Waters, and that it was to perish again by Fire; both which are arguments enough for a Providence, and of Gods particular care of the World: this I take to be his plain meaning; except *St. Peter* be to be understood in an Allegorical sense as well as *Moses*.

After this general discourse, he comes to a more particular consideration of the inconveniencies alledg'd against the parallelism of the Axis of the Earth, with the Axis of the Ecliptick. One argument I brought was, that by the present position of the Earths Axis, we receiv'd more of the Suns heat, than if it had mov'd always in the Equator; and if our heat at present is not too great for us, (as without doubt it is not) it was a very good reason why the present position should be esteem'd better than that the *Theorist* calls a right one, where-  
in

in we should not have so much of the Sun's influence, as we have. The *Defender* thinks this is no argument against the Theory, for says he, if the heat was equal and moderate in the temperate and habitable Climates, who would desire the extream heats of Summer? I answer, every one that observes how necessary the Summers heat is to the production of Vegetables, and the ripening of their seed, which could never be brought to any perfection, did the Sun shine always in the Equator, whereby the action of the Sun in our Latitude, would be little more than half of what it is at present in a Summers day, which therefore could never be sufficient for the growth and perfection of Vegetables. But (says he) how does this appear, supposing the heat constant? Are there no Vegetables in Jupiter which has still the position the Theorist gave the Primitive Earth, and which is vastly further distant from the Sun, and by consequence must have much less of his heat? Whether there are Vegetables in Jupiter, neither the Theorist nor I can determine, for we were never there to see, and I believe it was never revealed to him or any body else, that there are.

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But supposing there are vegetables there, what is that to us? Does he think them of the same nature and texture of parts that ours are of? Or that ours, if they were transplanted thither could grow and ripen in such a cold soil, when it is certain, that they require at least twenty five times a greater heat or influence from the Sun, than is in that Planet? Besides, it is requisite (as I shew'd in the Examination) that our plants and vegetables should have very different degrees of heat, and therefore there must be such changes and alterations in the seasons, as are necessary to produce the design'd effect; for that heat which is requir'd for the first growth and vegetation of a plant, will not be sufficient for the ripening and perfecting of the seed thereof, and that which is necessary for the bringing the seed to perfection, would quite wither the green and tender herb; and therefore, since this variety of seasons and alterations of heat, cannot be obtain'd either in *Jupiter* or in the *Theorist's* Antediluvian Earth; it is plain, that our plants could never have been brought to perfection in either of those places.

But it seems this *Defender* is of the opinion,

pinion, that the plants and vegetables of the Primitive Earth, were of a different nature and constitution from those we have now; so that he must think, that the nature of all our plants was perfectly alter'd and chang'd, or that God Almighty having destroy'd the old, was pleas'd to give us a quite new species of vegetables and plants; this is a miracle that is recorded no where in Scripture, or any where else that I know of, and I hope he will not think us oblig'd, on his word to believe it.

I affirm'd also, that if the Earth had such a position as the *Theorist* assign'd it, that the greatest part of it would not be habitable. For he himself acknowledges, that the Torrid Zone was uninhabitable in that Earth; and I am sure, that the greatest part of the two temperate Zones would not have sufficient heat to ripen their Corn and Fruits, and consequently would be nothing else but a Desert. To this he replies with this question, *How much less habitable would it be than the present Earth, where the open Sea which was not then, takes up half its surface?* I answer, that upon the same consideration I cannot see how any part of it should be habitable; for there be-

ing no open Sea, whose surface is expos'd to the heat of the Sun, I cannot imagine how there could be vapours enough drawn up to furnish the Earth with Waters, Dews, and Mists. For when it is requisite that one half of the Earths surface should be cover'd with water, on purpose to furnish vapours enough for Rain and Rivers, how can it be supply'd if there were no Sea at all? Can any Man suppose that the Sun acted as freely thro' a Crust of an immense thickness to raise vapours, as it does now upon the surface of the open Sea? This by the way, I think is a very good argument against the *Theorist*, who asserted, that the Primitive Earth had no Sea.

But the *Defender* thinks, that it would be very hard, if the seasons of the Year were the same as they are now; that the Inhabitants of the Earth should be confin'd to Herbs, Fruits and Water, especially in the colder Climates; where the Winters are so long, and the cold vehement; this he thinks, would be a most unmerciful imposition. Really as hard and unmerciful as it is, there are a very considerable number of people in these cold Countries, the greatest part of whose Food, is Bread, Herbs, Roots, Milk,



Milk, Cheese, and the like; and who seldom tast any Flesh-meats. And why might not the *Antediluvians* lead the same kind of life? I cannot see that the imposition is harder upon one than the other.

The *Defender* says, that the change of the position of the Earth's Axis, is matter of fact, and must be prov'd from History. And he wishes the Examiner would consult Antiquity, which would give him a more favourable opinion of the Theory as to this point. One would imagine by this, that this Gentleman had the Observations of some Antediluvian Astronomers to produce, who had found, that the inclination of the Earths Axis was chang'd from a perpendicular, into the present oblique posture: But instead of those, he only quotes some Philosophers, that did not live within some thousands of Years of the time, when this change was suppos'd to be made. What credit is there to be given to such a Tradition? Can we imagine, that there can be any thing certainly known from Authors that liv'd so long after the time of this change? Especially, when these men have said a thousand other things, that neither the

*Theorist*

*Theorist* nor any body else can believe? And yet, if we consider what they have said, we shall find it but very little to his purpose.

*Diogenes, Anaxagoras, Empedocles and Leucippus*, talked of the inclination, declination, or depression of the World towards the South, so that the Northern parts were rais'd higher, while the opposite parts slid towards the South. We may easily observe, that these Philosophers from their way of speaking, were no great Astronomers; it is hard to guess what they mean't by such sentences: But if we should take their meaning as the words at first seem to import, that one Pole of the Earth was more depressed, or inclined towards the Sun or the Ecliptick, than the other; the thing is absolutely false, for both the Poles are equally inclined to the Sun, or the Plane of the Ecliptick: (as I have sufficiently shew'n in the Examination \*) But whatever their meaning may be, I am sure, it is easier to draw any other consequence, than that which the *Theorist* has deduced from their words; nay it is probable, that they mean't the direct contrary to what he says they did, namely, that the Sun formerly came more towards

\* Pages  
79, 80, 81.

towards the North, than it does at present, and that its distance from them towards the South, is now greater than it was at first. This, one may easily deduce from the words of *Leucippus* as they are quoted by *Plutarch*, ὁ δὲ καὶ πρὸ παρε-  
πσάν τινι γὰρ εἰς τὰ μεσημβρινὰ μέρη διὰ τὸ  
ἐν ταῖς μεσημβρινοῖς ἀραιότητά αὐτὴ δὴ πικρὸς  
τῶν τῶν βορείων διὰ τὸ κατὰ φύσιν ταῖς κρυ-  
μοῖς, τῶν δὲ ἀντιθέτων πεπυρωμένων. *Leucip-  
pus terram in partes austrinas prolabi pu-  
tat ob istarum raritatem, quippe gelu con-  
cretis partibus Septentrionalibus, dum op-  
positæ interim ardent.* So that it seems ac-  
cording to *Leucippus*, the Sun acted more  
strongly upon the Northern Hemisphere  
formerly, than it does now, and that it  
does not now come so near the Zenith  
of those that live towards the North-  
Pole, as it did at first; whereby the wa-  
ters of these Northern parts are quite  
frozen and turn'd into Ice, while the  
parts toward the South, (being on the  
contrary expos'd to too great heat) are  
burnt and scorcht: that is, the declina-  
tion of the Ecliptick from the Equator  
(at least toward the North) was greater  
formerly than now.

Thus, we see how little favourable  
these Philosophers are to the *Theorist's*  
opinion;

opinion; and that their sentiments are at least as capable of being brought as arguments against him as for him.

It is true, that *Plato* speaks of ἀναρμονία καὶ ἀνομολία, a disharmony or irregularity in the motions of the Heavens, that was not under the reign of *Saturn*. But this signifies nothing to the *Theorist's* purpose; for if we should admit of his position, yet still there would be the same apparent irregularities in the motions of the Heavens. For the Planets would not in that case move uniformly round the Earth, but would have their directions, stations, and retrogradations, as they have at present; and none of them but the Sun would move precisely in the Equator. The other quotation the *Theorist* brings from *Plato*, is nothing to his purpose, and is alledg'd by another *Theorist*, to prove a quite contrary Hypothesis.

These are the testimonies the *Theorist* has produced from the old Philosophers, to prove the truth of his Hypothesis, which in my mind, if it were not for pomp and show, he might have as well let alone; for I think, they will prove any thing else just as well as what he design'd. If these Gentlemen had spoke  
of

of a coincidence that was at first between the Equator and the Ecliptick, or of the Axis of the Earth or World, being perpendicular to the Ecliptick, or if they had said, that the Sun at first mov'd always in the Equator, or that the days and nights throughout the the whole Year were equal, (which might have been easily said and much easier understood, than what they have deliver'd) they had spoke something to his purpose; but instead of this, we have some dark sentences, whose real meaning it is hard to guess at, and some of which seem to be so far from proving the *Theorists* position, that they seem rather to infer the contrary, and that the Suns declination was greater formerly than now. Sure a man must be put to a hard shift for ancient Traditions, that will bring such Testimonies to prove his point.

But the *Defender* alledges, that these places will at least prove that there was some change made in the state of nature formerly; and if I will not allow that which the *Theorist* has assign'd, I must shew some other which will have the same effects. Why so? I hope he does not suppose me to be like some  
Philo-

Philosophers, that think themselves oblig'd to give an account of every appearance, and fancy it a stain in their reputation and honour, to be ignorant in any thing: If he supposes such a thing, I assure him he is much mistaken; for I am sensible that there are more things which neither he nor I know than what we do. The Poets are the next witnesses the *Theorist* produces to prove the truth of his position: And these indeed talk of the continual spring and verdure of the Earth that was under the reign of *Saturn*. We know the Fable of the four Ages, of which the Golden was the first and best; in it they fancy'd every thing that was pleasant and delightful, and therefore they remov'd from it all extremities of heat and cold; and upon that account they would allow neither of Summer or Winter, but a perpetual Spring wherein every thing was fresh and blooming. But it is easie to perceive that all this was a figment: For when they or other Writers were to describe any pleasant places, they continually endow'd them with such qualities. Thus *Homer* describes the *Elysian* Fields as he is quoted by the *Theorist*, *Archæol. pag. 263.* and  
*Virgil*

*Virgil* supposes that there were fine green Meadows there. This Poet also in summing up the praises of *Italy* and preferring it before all other Countries, among other excellent qualities he endows it with a perpetual Spring,

*Hic ver assiduum atque alienis mensibus  
aestas.* Virg. Georg. Lib. II.

Thus *Plutarch* describes the fortunate Islands, and *Pliny* the *Loca Hyperborea*. From which we may clearly see, that there was no other foundation for any such assertion, but the fancy of the contrivers; who were to set forth their places of happiness to the best advantage.

But the *Defender* thinks, that if none of those he has mention'd will pass for sufficient witnesses of the matter of fact; yet I will certainly allow of the Testimonies of some ancient Astronomers, who have said something relating to this matter. Well, let us see what they say. He quotes *Baptista Mantuanus* from the *Archæolog.* whose words are these. *Erant illis (nempe Antediluvianis) ut Astronomiæ & experimento constat, Cæli propitiores; volunt namque Astronomi duos esse Zodiacos, unum in nona sphaera, alterum in octava, quod firmamentum vocant; & initio rerum & temporum sic à Deo dispositos ut Aries Arieti,*

*Arieti, Taurus Tauro, Gemini Geminis jungeretur, & amborum coeuntibus in unum viribus fortior fiebat in terris influxus, unde & herbas tunc salubriores, & fructus terræ meliores.* As also *Petrus Aponensis* in his *Conciliator Diff.* has these words, *Cum capita Zodiaci mobilis & immobilis ordinate & directe concurrebant, tum virtus perfectiori modo, à primo principio per medias causas taliter ordinatas fortiori modo imprimebatur in ista inferiora, cum causæ tunc sibi invicem correspondebant.*

These Testimonies I own do sufficiently convince me, not that the *Theorist's* position of the Primitive Earth was the true one; but that the *Defender* who has alledg'd them to prove his point does not understand them. For he could not have quoted any thing that was less to his purpose than they are. I know not what skill this Author has in the new Astronomy; but I am sure he does not understand it if it be put into an old fashion dress. No doubt he thought that these Authors mean't by such words that at first the Equator and Ecliptick were coincident; when they never dream't of any such thing.

They as their own words inform us, suppose with all the old Astronomers

two



two Zodiacks, the one of which is exactly placed under the other, and (the uppermost being immoveable) the lowest in which the fixed Stars are placed moves exactly under it, and performs its course from West to East, according to some in the space of 25000. Years. At first these two Circles had the same beginning, the Constellation *Aries* being exactly in the sign of the Ecliptick of the same name, and the Constellation *Taurus* was exactly in the sign *Taurus*; the Stars also that make up the figure of *Gemini*, were exactly under the sign *Gemini* of the immoveable Zodiack, and so in the rest. By which these Astrological Gentlemen thought, that both their forces being united, their efficacy and vertue upon the Earth would be very strong. But now that the moveable Zodiack has mov'd, these two Circles have not the same beginning, and the Stars that make up the figure of *Aries*, are not in the sign *Aries* but in *Taurus*, and those Stars which compose the sign of *Taurus*, are no more in *Taurus* but in *Gemini*, so the Stars of *Gemini* are got into *Cancer*, and those of *Cancer* into *Leo*, &c. as may plainly be seen on any Coelestial Globe. Which  
D they

they suppose to be perform'd by the motion of the eighth Sphere or the moveable Zodiack, of which all the old Astronomers speak, whom if he pleases he may consult; particularly he may read *Clavius's Notes on Sacrobosco de Sphæra*, which is as common and as good a Book as he can find on the subject.

But it seems the *Defender* thinks that this would appear more to his purpose, if the old fashion disguise were taken off, and the business apply'd to the true System of the Heavens. Well let us see if it is so. The new Astronomers suppose that the Stars are immoveable, and that the Earth turns round the Sun, so that its Axis makes always the acute Angle of  $66\frac{1}{2}^{\circ}$  with the Plane of its Orbit: if this Axis were perfectly directed to the same point of the Heavens, or mov'd always precisely parallel to its self, then the fix'd Stars would seem to have no other motion but the diurnal: But because the Earths Axis varies a little from an exact parallelism, and does not precisely point to the same Star when it is in the same place of its Orbit; but makes a small Angle with a line that obtains the position it had formerly in the same place; hence it happens

pens that the Equinoctial points or the common section of the Equator and the Ecliptick, retrocede or move backwards from East to West ; and this is that which the Astronomers call the precession of the Equinox, by which the fixed Stars seem to move from the West to the East with a very slow motion, and the Constellation *Aries* which at first was in the sign *Aries*, has now got into *Taurus*, and *Taurus* has seem'd to move into *Gemini*, *Gemini* into *Cancer*, &c. From hence it appears, that according either to the old or new Astronomers, the fixed Stars change their Longitude daily but not their Latitude, and they have always suppos'd that the Axis of the World has kept still the same Angle with the Plane of the Ecliptick. I will now leave it to any indifferent Reader, or even to the *Theorist* and his *Defender* to judge, if these quotations signify any thing to the purpose, or if they are not stronger arguments against the *Theorist's* position than for it.

Since the *Defender* has advis'd me to consult Antiquity, I suppose it will not be amiss to alledge the testimony of a very ancient Philosopher, whose authority ought at least to be as great as *Leu-*

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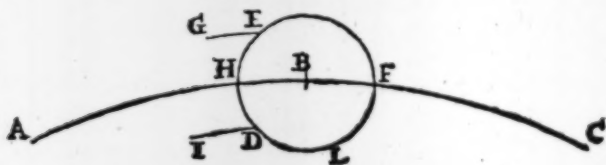
*cippus's,*

cippus's, Anaxagoras's, Empedocles's, or even Plato's; I mean the Divinely inspir'd *Moses*, who is the most ancient Writer that is now extant, and the only one who gives us an account of the state and condition of the Primitive World, of which the Philosophers adduced by the *Theorist* were altogether ignorant; in his Writings there is not one word of the coincidence of the Ecliptick and the Equator, or of the perpetual Equinox and Spring that was observ'd in the Primitive Earth. *Moses* supposes no such thing but rather the contrary, for in giving an account of the Creation he tells us, that *God said let there be lights in the firmament of the Heavens to divide the day from the night, and let them be for signs and for seasons, and for days, and for years*; from this it is observable, that *Moses* supposes that there were different seasons from the very Creation, and that their variety proceeded from the different motion of the Heavenly bodies, and more particularly of the Sun, whereas if the *Theorist's* Hypothesis had been true, the motion of the Sun could have made no variety of seasons; but the Year would have remain'd with the same face and tenour, having but one continued

tinued season. Thus it is evident, that the *Theorists* supposition in this matter, is directly contrary to that of *Moses*, and I think that his testimony ought to be of greater force with any candid Reader, even supposing that he had no Divine Inspiration, than any thing that could have been said by such Philosophers as the *Theorist* has brought, who lived not till many hundred years after *Moses*'s time.

After this dispute about matter of fact, our Author comes to defend the *Theorist*'s reason he gave for the Antediluvian position of the Earth. It is said in the Theory, that the Earth being an uniform and regular Body, having its Center of Gravity the same with its Center of Magnitude, it would naturally take an even and parallel position with the Axis of its Orbit. In reply to this I told him, that it was demonstrated by the Writers of *Hydrostaticks*, that a Sphere (or indeed any other body) whose Center of Gravity coincides with its Center of Magnitude, if put in a fluid of the same intensive Gravity with its self, will be indifferent to any position given. Our *Defenders* answer to this, is, *That such a thing may be*, that is, for ought

that he knows it may be so, *if the Sphere was resting; but if it was turned about its Axis and the Axis of the fluid, it would certainly take a position parallel to the Axis of the fluid.* I wonder who assur'd him of this; I can scarce believe he had any Letters from *Kensington* or any where else for it; otherwise he would have produced them as the grounds of his certainty. Well, tho' he is very sure of his point, yet perhaps it may not be true, and therefore we will inquire if it is so or not. Let *A B C* represent an Arch of the Ecliptick, or of any Circle parallel to it; *D E F* any Circle in the Earth lesser or greater in the same Plane with the Circle *A B C* let *H* be the point where the stream of the fluid falls



perpendicularly upon the Circle *D H E F* and take any two Arches *D H* and *E H* equal. The direction of the particles of the fluid falling upon the point *E* is *GE*, and of those which fall upon *D* is

D is I D, so that the lines G E, A H, and I D, are parallel. Because the particles which move from G to E come obliquely on the point E, part of their force will be spent in carrying or driving the Circle forward, and part of it will be employ'd in turning the Circle round an Axis perpendicular to the Plane A B C from H, to E and F. So that the total force of the particles is to that part of it which is used in turning the Circle round, as the square of the Radius to the Rectangle, contain'd between the Sine of the Arch H E and its Cosine; after the same manner part of the force of the particles which move from I to D and fall upon the point D will be spent in turning the Circle round from H D to L, so that the total force of the particles which rush upon D will be to the force by which they endeavour to turn the Circle round as the square of the Radius is to the Rectangle contain'd between the Sine of the Arch D H and its Cosine: and because the Arches H E, H D, are equal, it is plain the force of the streams of the fluid particles whereby they will endeavour to turn the Circle round its Axis must also be equal; but they being

contrary one to another will hinder the action of each other in turning the Circle round. Just so whatever is the force of the particles of the fluid which falls upon any point in turning the Circle round from H by E and F there is another force which is equal to it, and endeavours to move the Circle the contrary way from H to D and L, which two forces will hinder each others effect in turning the Circle round; the same thing is true of all the Circles that are parallel to the Ecliptick; and therefore the motion of the fluid has no sort of effect upon the Sphere to turn it round an Axis perpendicular to the Axis of the Ecliptick. But notwithstanding its own motion and the motion of the fluid, it will remain indifferent to move round any of its Diameters as an Axis, the fluid having no effect in making it turn round one Diameter more than another.

I found fault with the *Theorist* for saying the Earth was inclin'd to the Ecliptick, it being impossible to conceive how a Sphere can be inclin'd to a Plane, passing thro' its Center as the Ecliptick does thro' the Centre of the Earth. The *Defender* endeavours to excuse himself in this matter, telling us, it is the expression



pression of the ancient Philosophers, tho' he thinks it may be properly called an obliquation.

I would not have him raise a scandal on the ancient Philosophers without good grounds, which I scarce believe he has for his assertion; yet if they said any such thing, I did not think that the *Theorist* was so great an admirer of the old Philosophers, that in complaisance to them he would have spoken non-sense.

He tells me that *Situs rectus* is another expression I quarrel with; really tho' perhaps it is not very proper, I do not remember that I any where found fault with it; and he might have spared himself the trouble of citing a passage out of *Hugens* nothing to his purpose, for *Mons. Hugens* who always speaks sense, does not say that *Jupiter himself* but that his *Axis* is right to the Plane of his Orbit. But tho' the *Defender* endeavours to excuse the *Theorist* for his improprieties of expression, yet he passes over without any excuse the great error which he made in assigning the cause of the suppos'd change of position, which the Earths Axis suffer'd at the Deluge.

The *Theorist* said, that at first the Earth was equally pois'd, and therefore he  
thought

thought it must keep its Axis steady and parallel to the Axis of the Eliptick; but at the Deluge it lost the Equilibration as he calls it, and one end or Pole becoming heavier than the other, the heaviest end inclin'd towards the Sun, in which said posture he says the Earth has ever since continu'd. I must acknowledge that I could not read this without some indignation, and am ashamed to find one who pretends to give a Mechanical account of the Creation, and of the changes the World has since underwent, discourse in so crude a manner, that it may clearly be seen that he has not so much as a common insight into that learning, which would have taught him the present posture of the Earth and its Axis. For I shew'd in the Examination, that every one that understood the Elements of the new Astronomy, knew perfectly that one Pole of the Earth was not more inclin'd to the Sun than another; and that if such a change had really happen'd to the Earth, viz. that one Pole of it had become heavier than the other, that Pole had always inclin'd to the Sun and made a perpetual Summer in all the places of the Hemisphere, while the other enjoy'd  
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a continual Winter; and because no such thing happen'd, but both the Poles were equally inclin'd to the Sun, it was a demonstration that no such change of Gravitation happen'd to the Earth. The *Defender* is pleas'd to take no notice of this argument, and yet has the confidence to assert, that he thinks the *Theorist's* reasons very probable for the causes of the suppos'd change of the position of the Earths Axis.

But the *Theorist* in the last Edition of his *English Theory*, seems to have found out another cause which he thinks in some measure contributed to the change of the Earth's position, and that it is the change of the Direction of the Magnetick particles, which he says followed upon the dissolution of the Earth. But before we can know if this would do, we must discover what these Magnetick particles are, what their direction is, what it was before the Deluge, what afterwards, how it came to be chang'd, and how this change produced a change in the position of the Earths Axis. And till he pretend to give a Mechanical account of these things, he can no more expect a distinct answer from me, than if he had said all this had been done by  
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some occult quality. For loose and general Harangues about Effluviūms, Particles, subtle Matter, Modes and Motions, signify very little more to explain Nature, than the Qualities and Attractions of the old Philosophers, (whom the *Theorist* upon this account so often derides) 'tis indeed but another sort of Cant, and affords as little satisfaction to the mind. Before I proceed any further, I must own I was mistaken when I said, that the Axis of *Jupiter* was oblique to the Plane of its Orbit. In reading of *Hugen's Systema Saturninum*, I remember'd that this position was affirm'd of *Saturn*, and I thought that I had read there that *Jupiter* had a like position, which I wrote down without consulting the Book it self, which I had not then by me.

The *Defender* has mistaken my meaning, when he imagines I said, that according to the *Theorist* both *Jupiter* and *Saturn* were Antediluvian Planets; for the particle *whom* in the parenthesis, refers only to *Jupiter*, tho' in the mean time I own the expression is ambiguous, and may refer to both.

At last the *Defender* comes to give us a short account of the *Theorist's* Creed as to

to this point, which he conceives to be thus, *The Earth was at first in an even and parallel posture with the Axis of the Sun, or (as he explains himself in the 2<sup>d</sup>. Page of his Reflections) its Axis was not oblique to the Axis of the Sun or the Ecliptick, but lay parallel with the Axis of the Sun, and perpendicular to the Plane of the Ecliptick. Then the Earth had a perpetual Equinox and unity of Seasons, and the Heavens and fixed Stars moved uniformly and concentrically with the Earth; but when the Earth changed its posture into that which it has now, it had the position of its Axis chang'd into a parallelism with the Axis of the Equator, and the Heavens seem'd to turn round upon another Axis different from those of the Sun or the Earth.* I must beg this Author's leave to say, that he has grossly misrepresented the *Theorist*, who, so far as I can discover never expressed himself to any such purpose. I thought that there were already errors enough in this Theory, so that he needed not have made them more by false misrepresentations. For I can find no such thing in either the *Latin* or *English* Theory, as that the Axis of the Earth was ever parallel to the Axis of the Sun. It is said indeed that the Axis of the Earth was parallel

parallel to the Axis of the Ecliptick, and perpendicular to its Plane, and this I must own is false; but were it true, yet what the *Defender* advances upon it would be impossible, viz. that the Axis of the Earth would also be parallel to the Axis of the Sun, for since the Axis of the Sun is not perpendicular, but stands at oblique Angles upon the Plane of the Ecliptick, as is evident from *Gallileo* in his Book *de Macchie Solari*, *Scheiners Rosa Ursina*, *Kepler*, *Monf. Cassini*, *Mr. Flamsteed*, and most of the Astronomers who have wrote upon this subject: but even his own Master *Des Cartes*, (from whom he seems as industriously to dissent when he is in the right, as he is always sure to transcribe him when he is in the wrong) tells us, that the Axis of the Sun makes an Angle of seven degrees with the Axis of the Ecliptick: If I say what these Learned Men have observ'd be true, then either the proposition advanced by the *Defender*, or the 8th. of the 11th. of *Euclid* must be false. This Author also tells us, that before the Deluge (the Earth having a right position) the Heavens with the fixed Stars mov'd or seem'd to move concentrically with the Earth. I cannot suppose that he mean't by this, that

that all the fixed Stars seem'd to turn round the Earth in Circles, that have the Axis of the Earth for their Axis, for they do so now, and must do so whatever position the Earth obtains, if the motions of the Stars be only apparent and caused by the real rotation of the Earth round its Axis.

I fancy therefore that by a concentric motion he means, (if he means any thing) that which is perform'd in a Circle which has the same Centre that the Earth has, (as the word implies) and I am confirm'd in the opinion, that this or some other strange thing is mean't by this word, because the *Theorist* in his *Archæolog.* asserts, that in his Primitive Earth all its Inhabitants would be *Ascii*, that is, they would have no shadow at twelve of the Clock, or they would have the Sun vertical to them at that time. This I dare venture to say is impossible in this or any other of the numberless Worlds, that the *Defender* dreams of among the fixed Stars, unless the Sun can be multiply'd or made to appear at many different places at the same time. For every one that ever read any one Page about the first principles of Geography knows, that all those who live  
under

under the same Meridian have twelve of the Clock at the same time, and consequently if the Sun were at twelve of the Clock vertical to all those who live under it, he must be in every point of that Meridian at the same time. I leave the Reader to judge if these men whose notions in Astronomy and Geography are so distinct and clear, are not very capable of making Theories and discourses about the posture of the Primitive Earth, and the position of its Axis? They should be advis'd before ever they venture again to make another Theory, or defend this, to learn something of the common principles of the Sphere. Perhaps they think them too common and easy, and such as every body may know that will be at the pains to study, and therefore they despise them, and go upon higher attempts to find out something that no body else can discover; as the method how the Earth was made, and what was the state and condition of the Antediluvian World. But for my part I would rather be quite ignorant of the posture of the Primitive Earth and the position of its Axis, than not know the common principles of Astronomy and the doctrine of the Sphere.

I am



I am sure if this Author had spent but half the time upon this subject that he has done upon the Theory, he might have avoided many absurdities, and would not have talk't of the Axis of the Earth being chang'd into a parallelism with the Axis of the Equator, and the Heavens seeming to turn round upon an Axis different from that of the Earth. For it is well known, that the apparent motion of the Heavens is about the Axis of the Earth, and that the Axis of the Equator is the same with the Earths Axis, and it is impossible that they could ever have been distinct.

It seems this *Defender's* acquaintance is only with the Antediluvian World; for one would think by his way of writing, that he knew nothing at all of this Worlds position or motions. His discourse and terms are so odd and strange, that I sometimes believe they were terms that were used by the Antediluvian Fathers; for I am sure they cannot be accommodated to the present mode and manner of speaking.

The design of the fifth Chapter of the Examination is, to consider the *Theorist's* method of forming Rivers in  
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the Primitive Earth; which, according to him were furnished with Vapours drawn from the Abyfs thro' the Crust by the heat of the Sun. Against this I objected that from thence it would follow, that there could be no Rivers for a considerable time after the first Creation of the Earth. For one would think that it must necessarily require some time before the Suns heat could penetrate thro' a thick Crust to raise vapours from the Abyfs; all which time the Inhabitants of the Earth must be without Rivers. The *Defender* thinks this objection may be answered by saying, that the Earth was at first soft and moist, and therefore could not but furnish store of vapours to supply the Rivers. But this is nothing but a shift; for if we bring it to a Calculation, we shall find the cause no ways answerable to the effect.

I shew'd in the Examination, that the quantity of water evacuated by all the Rivers every Year, was at least equal to 263080. Cubical Miles; now if we allow no more Rivers in the Primitive Earth than there are now in ours, (whereas in our proportion to the surface of the Land they ought to be double) so many Cubical Miles of water will likewise be  
necessary

necessary every Year to supply the Primitive Rivers; and if we admit that the Sun had penetrated the thick Crust in the space of ten Years (which is a time little enough in all reason for such an effect) the quantity of water that would be necessary to supply the Rivers for such a time, must not be less than 263080. Cubical Miles; which is such a quantity as would make the Earth very soft and moist indeed: But it would be much rather a Marsh and Mire than an habitable Earth.

I objected also that it was impossible that the Rays of the Sun could ever reach thro' a vast thick Crust, so as to be able to raise vapours from the Abyss. Or if we should suppose that it did raise them, yet it could not do it in such a quantity as would be requisite to furnish the Antediluvian Rivers. For who can imagine that the Sun could act as freely upon the Abyss, as it does now upon the open Sea? Whose surface is expos'd to the continual heat of the Sun, whereas the Abyss was inclos'd by a thick Crustation, in which were all the Materials of Earth, Sand, Clay, Gravel, Ores, and Metalline substances? And seeing the Sea as it is now laid open to the action

of the Sun, is but just sufficient to supply us with Rain and Vapours; does it not seem a thing against common sense to suppose that the Abyss inclos'd with a thick shell could have sent out a quantity of Vapours great enough for such an effect?

But I pass'd from these general words, and reduced the matter to Calculation; where I shew'd, that if we allow'd the mouths of all the Pores, Cracks and Chaps, thro' which the Sun must have acted on the Abyss to have been  $\frac{1}{10000}$  part of the Earth's surface; there would then have been five thousand times less Vapours to have serv'd twice as great a quantity of dry Land; and therefore that in a Country as bigg as *Britain*, there would not have been so much as one River, nor so much Rain in a Year as does now fall in a day. All the answer the *Defender* makes to this, is, that I suppose great cracks and pitts thro' which the Vapours ascended, whose dimensions and capacities I examine at pleasure, whereas he does not find that the *Theorist* makes any mention of these Cracks for that purpose; The only question is, whither the heat of the Sun could reach so low  
as

as the Abyfs, when the Earth was dry'd and its Pores enlarged. Here he is mistaken, this is not the only question; for there is another material one besides, *viz.* That supposing the heat of the Sun had reached the Abyfs, whether there could have been vapours enough extracted from it to furnish the Earth. And I think I have prov'd that there could not.

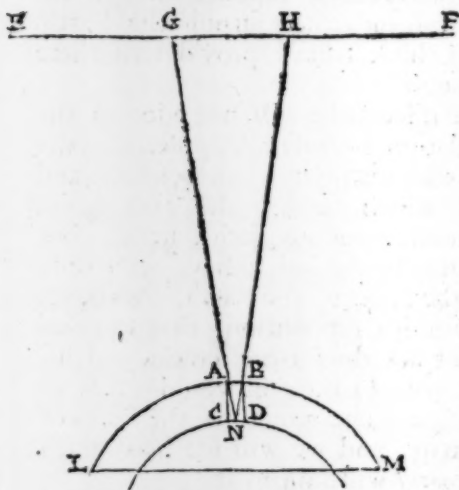
But it seems he will not allow of the Calculation, because it supposes, that the Sun acted thro' large cracks, fissures and chaps, which he says the *Theorist* did not mention for any such purpose: but he will have the Sun to have acted only thro' the Pores of the Earth. Well, let us grant his supposition, that the Sun did not act thro' large cracks and fissures, (which I thought would best serve his designe) but only thro' the Pores of the Earth; and we will see how much the *Theorist* will gain by it.

Let us therefore consider one of these Pores, which we will suppose to be one inch Diameter; (and I think it a good large one) let us also suppose that the Crust from its surface to the Abyfs is but one Mile thick, which is but a very moderate supposition, as in the figure, where

E 3

A B

AB represents the mouth of one of these Pores, AC the thickness of the Cruft, CND the surface of the Abyfs, EGHF the Diameter of the Sun; GH is the Diameter of that part of the Sun which can shine all at once upon the



point N, which is midway betwixt C and D. because AC is to CN as 5000. to half an inch, that is, as 120000. to 1. the Angle CAN will be somewhat less than two seconds; and therefore the double of it which is the Angle ANB or GNH will be less than four seconds; but

but the whole Diameter of the Sun subtends an Angle of 30. minutes; therefore EF the Diameter of the Sun, is to GH the Diameter of that part which shines thro' the Pore AB as 30. minutes are to four seconds, that is, as 1800. to 4. or 450. to 1. But Circles are to one another as the squares of their Diameters, and consequently the Disk of the Sun which shines all at once upon our Sea, is to that part of it which shines upon the Abyfs thro' its Pores, as the square of 450. to 1. that is, as 202500. to 1; and therefore the action of the Sun upon the surface of the Abyfs, would not be the two hundred thousandth part of what it is upon the surface of our new Ocean. But 'tis plain by the Figure, that the Sun could not shine the ten thousandth part of the time upon the Abyfs, that it can do upon the Sea. And therefore if we diminish its action also upon that account, we shall find that the heat of the Sun upon the Abyfs, would not be the ten milloneth part of what is upon the present Sea; and the vapours raised from the Abyfs, would be less than those which are raised from the Sea very near in the same proportion. Has not the *Theorist* now mended his cause mightily

by this answer of his *Defenders*, which has made the argument against him much stronger than it was before?

I am accused of dealing unfairly with the *Theorist*, when I make him suppose that Mountains make way for the motion and dilatation of vapours. If this is unfair dealing, I cannot tell what will be fair; for the *Theorist* himself has expressly said so, in his Book II. Chap. 5. Parag. 4. of the *English Theory*. Where, speaking of the North and South parts of the World, which he says draw the vapours to them; his words are these, *The cold of those parts attracting them, as we call it, that is making way to their motion and dilatation without resistance, as Mountains and cold places usually draw vapours from the warmer*. Tho' I quoted these words in the Examination, yet the *Defender* assures us, that the *Theorist* supposes no such thing. It seems then that he can say one thing, and suppose another. If so, I wish the *Defender* would give us two Catalogues, one of those things which he says and supposes to be true, and another of those things he says without supposing them to be true; I hope in this last we should find what is said in the 7th, 8th, and 9th. Chapters



ters of the *Archæologia*, concerning the *Mosaical* account of the Formation of the World, its Primitive State, and the Fall of Man.

Our next dispute is about the course of the vapours. The *Theorist* asserted, that it would be towards North and South. Now I prov'd that it would be from East to West; because I demonstrated, that there must be a continual wind blowing that way, in an Earth where there were no Mountains to change the direction of the wind; just as it is now in the *Atlantick* and *Pacifick* Oceans. And seeing the vapours swim in an Air of the same intensive gravity with themselves, it is demonstrable that they must follow the motion of that Air, and be likewise carry'd from East to West. The *Defender* grants, that their motion would be at first that way; But (says he) the question here is, where they would be condensed or where they would fall. I think it does not signify any thing where they fall; for I am sure they would not fall or be condensed in a place to which they were never carry'd, that is, towards either of the Poles.

The *Theorist* was of the opinion that the cold in the North and South parts  
attracted

attracted the vapours thither, that is, (as he explains it) made way for their motion and dilatation. But because I shew'd that this method savoured a little of absurdity, our Theory-mender says, that the vapours were diverted towards North and South, by an impulse of new vapours. This opinion seems to me to be as unnatural as the other, for if the vapours were crouded on one another by their mutual impulses, they would condense one another, and fall down in the places where they were crouded.

I am sure it is impossible, that an atome of vapour however impell'd, should make its way thro' an Atmosphere of the same gravity with its self, for some thousands of Miles towards either of the Poles; when a stone which has some thousand times more density than vapours, and consequently some thousands of times also more force to break the resistance of the medium, if it were to move to Eternity in the Air, yet it would never make any considerable way in the medium, by reason of the continual loss of its motion.

It seems to contradict our senses to suppose, that vapours can move thro' the Air without suffering such a resistance

stance as must condense them. We observe, that those vapours which are in the Clouds, when the Air grows light, begin to fall, no doubt in the form of vapours; but afterwards suffering a considerable resistance from the Air, they are condensed into drops of Rain. If then the resistance the vapours meet with for so small a way, be sufficient to condense them, is it not naturally impossible that they should travel some thousands of Miles and not be condensed till they arrive at the Poles?

Our Author proceeds in the next place to consider the seventh Chapter of the Examination, and answer the arguments that are brought against the *Theorist's* way of making a Deluge. It is suppos'd in the Theory, that after some ages the heat of the Sun must have peirc'd thro' the Crust of the Earth, and reached the Abyss, where it must have rarify'd the waters there, and rais'd an immense quantity of them into vapours, these endeavouring to expand themselves, and the Pores of the Earth not being sufficient to let them pass thro', would press upon the Crust and break it into peices, so that its fall upon the Abyss, would produce an uniyersal Deluge. Against this I objected,

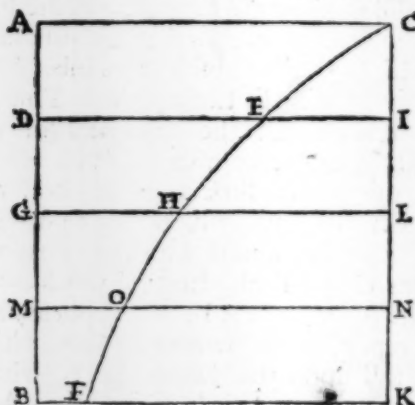
jected, that it is impossible the heat of the Sun could reach far into the Earth, so as to perform any considerable effect; since by observation it was found, that in Caves and Vaults there was not any sensible alteration of heat in Summer and Winter; and therefore seeing that the heat of the Sun had so little effect in places of the Earth that were so near its surface, how could any one imagine that it would have any upon the Abyss which was covered over with a thick Crust.

But because this argument was propos'd in general terms, I endeavour'd to bring it to Calculation, in order to which I assumed one postulatum, *viz.* That fewer Rays of heat passed to the Abyss thro' the Crust, than if it had been compos'd of several surfaces at some considerable distance from one another, (suppose 10. 20. or 30. feet.) every one of which reflected half the Rays which fell upon them, and transmitted the other half. This I thought was a postulatum which every body would have granted; and if we consider how much of the Sun's light and heat is diminished by a thin Cloud of vapours, placed between it and us, and how much light is reflected by

by the common Air, when it passes thro' it, we cannot but own that the diminution of heat in passing thro' every 20. or 30. foot of a solid Crust, must be at least the half of what falls upon it. Upon this supposition I shew'd, that if there were but one hundred of these surfaces, the number of Rays which fell upon the first, would be to the number of Rays which fell upon the last, as  $2^{99}$  to 1. or as the 99<sup>th</sup>. power of 2. to unity; from whence it followed, that if we took the distances as the Logarithms, the heat of the Sun at each of these distances, would be as the absolute numbers belonging to these Logarithms; Thus, if AB represented the thickness of the Crust, AC the number of Rays which fell upon the surface at A, DE the number of Rays which fell upon the surface at D; and if we draw thro' the points C and E the Logarithmick curve to the Asymptote AB, the Applicate BF will represent the number of Rays which will fall upon the surface at B, which in our present case is vastly less than AC.

Instead of denying any of the propositions of this argument, or shewing how the conclusion is fallly deduced from the premises, he answers that so we may divide

vide an inch into an hundred or a thousand surfaces, and prove from thence that no heat of the Sun could pierce thro' an inch of Earth. But is this a parallel case, is there not a vast disproportion between an inch of Earth, and a vast dense Crust of some Miles thickness? So that the postulatum which is true in the one case, cannot be suppos'd to be true in the other; if we should suppose as many surfaces in one inch of Earth as we did in the whole Crust, then



the distance between any two immediate surfaces of the Crust, would be to the distance between two immediate surfaces of the inch of Earth, as the thickness of the

the Crust to the thickness of an inch; and consequently if AD represent the distance between the two first surfaces of the inch of Earth, AB the distance between the two first surfaces of the Crust, AC the Rays which fall on the first surface of both, ED the number of Rays which fall on the surface at D; the line FB which is the Applicate of the Logarithmick curve DEF, will represent the number of Rays which fall on the surface at B. For it is certain that the deeper any Rays pass in any medium whether solid or fluid, they are still the fewer, and both light and heat are more and more diminished. Thus the Rays of the Sun passing thro' a far greater portion of the Air when it is near the *Horizon*, than when it is near the *Zenith*, is the cause that its light near the *Horizon* is much less than when he is in his Meridian Altitude; and the difference of his Illumination in both these places is so great, that we can easily look upon the Sun when he is Setting or Rising, whereas we cannot turn our eyes to him without hurting them, when he is near our *Zenith*. Thus also it is observ'd by experience, that the deeper any Pool of water is, the fewer are the Rays which

I reach

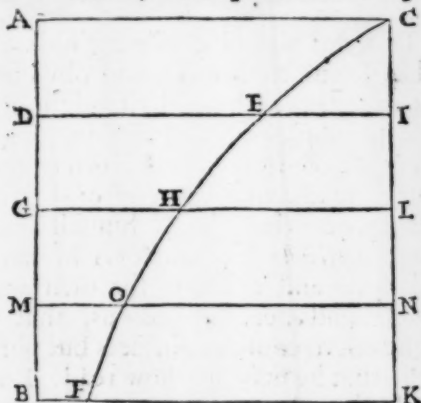
reach to the bottom of it; the same thing is also observ'd, if the medium is Glafs or Chryſtal, or any other that lets either light or heat paſs thro' it.

Perhaps the *Defender* will ſay, that the Rays are diminifhed in paſſing thro' a medium; but yet he does not ſee how they ſhould be diminifhed in the proportion I have aſſign'd, *viz.* ſo that the Applicates to the Logarithmick curve are always as the quantity of Rays which paſs thro'. Well, that he may ſee that this is not a precarious aſſumption, I will give him my reaſon for it.

Let  $ABKC$  repreſent any medium thro' which the Rays paſs; let us ſuppoſe this medium to be divided into parts of equal thickneſs,  $AD, DG, GM$ , &c. let  $a$  repreſent the number of Rays which fall on the ſurface  $AC$ , and let  ${}_m a$  be thoſe which paſs thro' to the ſurface  $DI$ ; becauſe the mediums  $AI, DL$ , are uniform, they will both tranſmit the light which falls upon them, in the ſame proportion, that is, becauſe both theſe mediums are by ſuppoſition of the ſame nature, equally denſe, and of the ſame thickneſs, and the Rays which fall upon both, have the ſame inclination, the  
quantity



quantity of Rays which fall upon the surface AC, will be to the quantity which passes thro' the medium AI and comes to the surface DI as that quantity which comes to DI is to the quantity which passes thro' DL, and comes to LG and by consequence if  $a$  repre-



sent the number of Rays which fall upon AC,  $\frac{1}{m}a$  the number which fall upon DI,  $\frac{m}{1}a$  will represent the number of those that fall upon the surface GL. After the same manner  $\frac{m^2}{1}a$  will be as the number of those Rays which come to MN, and  $\frac{m^3}{1}a$  will be the number of those which fall upon FB, that is, If the  

F
distances

distances AD, AG, AM, AB, are in an Arithmetical progression, the Applicates AC, DE, GH, MO, FB, which represent the number of Rays that come to the points A, D, G, M, B, respectively, will be in a Geometrical progression, which is the property of the Logarithmick curve.

Tho' this way of reasoning by a Calculus, seems to be plain and obvious enough to those who understand the common principles of Calculation, (which as I think ought to be unknown to none that pretend either to write or defend a Theory, as the *Theorist* himself owns) yet the *Defender* does whatever he can to find shifts and evasions for such arguments; and here he tells us, that we ought not to consider surfaces but pores. Well, that he may see how ready I am to please and obey him, I have done this already in the 71. Page of this Treatise, where I have shew'd, that if the Sun shin'd upon any surface that is exposed openly to it, its heat on that surface would be 202500. times greater than its heat upon the surface of the Abyſs, when it shin'd only thro' the Pores of the Cruſt. Which disproportion is great enough to shew, that no great store of vapours

vapours could be rarify'd in the Abyfs. But says he, those that allow a Comet at its nearest approach to the Sun, to be peirced thro' and thro', so as to become hotter than red hot iron, will not think it strange that at our distance, it should have some proportional effect upon the inward parts of the Earth. Let us illustrate his similitude by another; Those who allow that a ball of iron ten inches thick, when put in a good fire may be made red hot, and be peirced by the fire thro' and thro', will not think it strange, that this ball of iron remov'd 10. feet from the fire, should receive some proportionable heat even in its inward parts, as without doubt it would. But the question is, if this effect is any way sensible, or if we should suppose some water inclosed in the middle of this ball, whether the heat of the fire could raise it into vapour at such a distance, so that the force those vapours have to expand themselves, would break or burst the ball.

I thought that this Gentleman had known so much of the new Experimental Philosophy, as not to be ignorant, that heat does not pass into the interior parts of a solid of considerable thickness, till it has quite dissolv'd the Exterior

parts; and if the solid is combustible, (as wood) it consumes the outward parts, before it has any sensible effect upon the Interior; but if its parts are compact, (as Metals or Stone) it loosens and dissolves the frame and texture of the outward parts, and so makes its way to the inward.

But our Philosopher thinks he has found out one remarkable *Phænomenon*, by which he can prove effectually, that the heat of the Sun peirces deep into the Crust, and that is in the case of the Earth-quakes. He considers the cause of them, and their depths, and he says, that all agree that they arise from the rarefaction of Vapours and Exhalations; This rarefaction (says he) must be made by some heat, and no other is prov'd to us yet by this Author, than the heat of the Sun.

Why should I be oblig'd to satisfy him in all his difficulties in Philosophy? Did ever I set up to be a *Theorist*, and give an account of all the *Phænomena* of Nature? Well; but it seems he expects it from me, and tho' I am no ways oblig'd to it, yet out of abundance of good nature, I will give my opinion in this matter.

I think

I think then that the rarefaction of Vapours within the Earth, may arise from another heat than that of the Sun. We know that there is an actual fire which always burns in several places of it, which sometimes bursts out and makes an horrible eruption, as in all Vulcano's and Fiery Mountains; and why may not this fire be the cause of the rarefaction? This appears to be more probable, because Earth-quakes are most common in those places where these Vulcanos are, as in the Kingdom of *Naples* and *Sicily*.

But supposing there were no actual fire under ground, yet I am of the opinion, that heat may arise from other causes than that of the Sun. It is observ'd, that from a due mixture of some particles of matter with those of another sort, there will arise a very considerable heat: Some places underground are observ'd to be exceeding hot, as some Mines, (where there is a mixture of Sulphureous, Nitrous, and Mineral principles) the heat is so considerable, that a Man cannot easily endure it, even in the extremity of Winter. There are other places so warm, that the waters that run thro' them will scald a Mans hand. And may we not suppose, that there are some Ca-

vities deeper underground, where the Earth is of the same frame and texture of parts? Now if some Sulphureous and Nitrous Exhalations, should be gathered together within any of these Cavities, and by motion, or any other accident, they should happen to be kindled, it is plain they will expand themselves, rarify the Air, and make that Concussion of the ground we usually observe in Earth-quakes.

Now it is plain, that these Exhalations may be kindled without the heat of the Sun, from observations that are daily to be made in our Atmosphere; where the Sulphureous Exhalations that are the cause of Thunder and Lightning are kindled in the Air, when the action of the Sun is not strong. This is also observ'd of Meteors, (which we commonly call falling Stars) whose matter is kindled in the night-time, when the immediate heat of the Sun can have as little effect as it has within the bowels of the Earth: and I hope this will be sufficient to satisfy him, that Earth-quakes may arise from other causes than the heat of the Sun.

Tho' the arguments I have already given, clearly prove, that there was no rarefaction

rarefaction of the vapours, caused by the heat of the Sun within the Abyfs, yet I shew'd, that granting the Suns heat had reach't the Abyfs, even then an Universal Deluge could not follow from thence; because I demonstrated by a Calculation, that if the Suns heat drew vapours from the Abyfs sufficient to furnish the Rivers on the Earth, it must have exhausted this great treasure long before the time of the Deluge. This manner of Examining the *Defender* calls contention, and going from one extream to another; tho' for my part, I think there cannot be fairer dealing, than first to prove that his Principles and Hypotheses are false and disagreeable to Nature; and then (supposing them true) to shew, that his reasonings upon 'em are false and inconclusive, and the causes he assigns, are no ways proportionable to the effects he would account for.

However, our Author assures us, that there are a great many uncertainties in the computation. He knows I did not pretend to give an exact estimation of the Water that the Rivers sent into the Sea. I can suppose that I have not come within the truth by one, two, or three Cubical Miles of Water, (which is

as much as I need to allow) nay, I will grant him, that I have erred a twentieth part, or even one half if he pleases, and yet the argument will be strong enough. For according to the computation, the Abyfs ought to have been exhausted in the space of 460. Years; now from the Creation to the time of the Deluge, there were 1600. Years. By which it is evident, that which ever of these Hypotheses he takes, the Abyfs must have been empty long before the time of the Deluge.

But he thinks I go in this Calculation on principles that are not allow'd by the *Theorist*, because I suppose the Waters of the present Sea equal to the Waters of the great Abyfs; whereas (says he) there was near twice as much Water in the great deep, as is now in the Ocean, seeing the Abyfs was extended under the whole Earth, and the Sea reaches but to the half of it. I always presum'd that it was the *Theorist's* Hypothesis, that the Crust fell down upon the Abyfs and drove the Waters from their place, so that the greatest part of the Waters in the Abyfs (after they had overflowed the Earth) came and settled at last in the Sea. There might indeed have been some Water left in the Hollows and Cavities



vities of the Earth, but 'twould be inconsiderable in respect of the whole; and the *Theorist* himself asserts, that if the Earth should disgorge all the Waters in its bowels, it would not amount to above half an Ocean; and in the *Latin* Edition he thinks, that it is altogether incredible, that the Water within the Earth should be as great as what is in the Sea and Rivers. So that this Gentleman, who asserts that there was almost twice as much Water in the Abyſs as there is now in the Ocean, seems never to have read the Theory, or to have understood the *Theorist's* Hypothesis which he endeavours to defend.

But what if there were twice as much Water in the Abyſs as there is now in the Ocean; yet even in that case the whole must have been exhausted long before the Deluge, since one Ocean could have been drawn up in the space of 460. Years: Nay, if we suppose that there were but just so many Rivers in the Primitive Earth as there are now in ours; (whereas in proportion to the dry Land there ought to have been twice as many) yet in the space of 1600. Years, there is time enough to have the whole Abyſs exhausted, as is evident by the Calculation.

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The *Defender* alledges, that the Rivers were not supply'd by the vapours, only from the Abyſs, but alſo from the Earth and Waters upon it. This evasion was foreſeen, and obviated by me in the 165. Page of the Examination; where I prov'd that there muſt be at leaſt the ſame quantity of vapour exhal'd from the Abyſs as was before, becauſe the ſame cauſe ſtill continuing to act, would ſtill produce the ſame effect, and the Abyſs having at firſt furniſhed the Rivers with a ſufficient quantity of Water, would ſtill continue to furniſh 'em in the ſame quantity, nay rather in a much greater; ſince (according to the Theory) the heat of the Sun was ſtronger and ſtronger every day upon the Abyſs, and the vapours exhal'd were ſo many at laſt, that not being all of them able to crowd thro' the Pores, they broke the thick Cruſt of the Earth with their violent effect to expand themſelves and fly upwards. Thus we ſee all the ſhifts and evaſions which this Author makes, are not of the leaſt weight againſt my computation.

But ſuppoſing that all the Water in the preſent Ocean was then in the Abyſs, yet I prov'd, that from the fall of the Cruſt,

Crust, there could arise no Universal Deluge, because the *Theorist* himself prov'd, that there must be at least eight Oceans of Water requir'd to cover the Earth. The *Defender* confesses, that the Water in the Abyss was not sufficient to make a Deluge in the nature of a standing Pool, over-topping and standing calm over the heads of the highest Mountains; (as it is usually conceiv'd) but the Deluge that rose from the fall of the Crust was rather like a rushing Sea, overflowing and sweeping them with its Raging Waves and Impetuous Fluctuations. I beg the *Theorist's* pardon for mistaking him: I thought that he design'd to explain *Noah's* Deluge, and not one of his own imagination. Now I can easily prove, that such a Deluge as this Gentleman conceives, is no ways like that which happen'd in the days of *Noah*. For tho' the *Theorist* computed but eight Oceans of Water that were sufficient to cover the whole Earth above the tops of the highest Mountains, yet I determin'd the quantity more nicely in my Remarks on Mr. *Whistons* Theory, where I prov'd, that there must be at least three and twenty Oceans of Water that were necessary for such an effect. From which

which it is evident, that the Water in the Abyſs could but cover one part of twenty three at a time; and the other twenty two parts muſt remain dry; and that after the Water had overflowed this part, it muſt have proceeded to the next, and ſo ſucceſſively, till at laſt it had overflow'd the whole Earth. This is the way that our Author muſt conceive the Deluge.

Let us ſee now what account the Scriptures give us of Noahs Deluge. *Genef. Chap. 7. v. 2.* it is ſaid, *That the fountains of the great deep were broken up, and the windows of heaven were opened, and the rain was upon the Earth forty days and forty nights.* And again, *verſ. 17. And the flood was forty days upon the Earth, and the waters increaſed and bare up the Ark, and it was liſt up above the Earth.* *verſ. 18. And the waters prevail'd, and were increaſed greatly upon the Earth, and the Ark went upon the face of the waters.* *verſ. 19. And the waters prevail'd exceedingly upon the Earth, and all the high hills that were under the whole heavens were covered.* *verſ. 20. Fifteen cubits upwards did the waters prevail, and the mountains were covered.* *verſ. 24. And the waters prevail'd upon the Earth an hundred and fifty days.*  
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Chap. 8. ver. 1. *And God made a wind to pass over the Earth, and the waters asswaged.* ver. 2. *The fountains also of the deep and the windows of heaven were stopped, and the rain from heaven was restrained.* ver. 3. *And the waters returned from off the Earth continually, and after the end of the hundred and fifty days, the waters were abated.* ver. 5. *And the waters decreased continually until the tenth month. In the tenth month, on the fifth day of the month were the tops of the mountains seen.*

We may observe from this, that the Scriptures inform us, that the whole Earth was under a Deluge at the same time, that the waters increased and prevailed gradually every where for the space of 150. days, that all the high hills under the whole heavens were covered, that all these Mountains lay under Water for several months, that the Ark swam and was carry'd up above the Mountains, and when the Waters began to abate, it rested at last upon one of them; that it was the eighth month from the beginning of the Deluge when the tops of the Mountains first began to appear, till which time they lay all of them hid and covered with Water. Now in the *Theorist's* imaginary Deluge,  
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it is plain, (as I have already observ'd) that there was but a twenty third part of the Earth covered with Water at the same time; it is also evident, that the Waters could not increase gradually in any one place for the space of 150. days, since the whole Earth was to be cover'd over with waters in that time. His single Ocean of Water could not stay but the three and twentieth part of that time in one place, and therefore it must have gone off from that place, and left it dry long before the end of those days.

Nor is this Idea of a Deluge less consistent with Reason and Philosophy, than it is with Scripture. Is it possible to conceive a moving, wandering Mountain of Water? For Water naturally settles its self into a surface concentric to the Earth; and by whatever force, or however it should be rais'd into an heap, it will immediately spread it self uniformly upon the surface of the Earth, and descend by whatever ways it can. If therefore we should suppose all the waters in the Abyss drawn or forced up to cover the hills of any one place, it will immediately descend and form it self into a surface parallel to the *Horizon*, and so spread its self equally every where upon the  
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the Valleys of the Earth, leaving the Mountains quite uncover'd. The *Theorist* himself acknowledges, that a Mountain of Water is an impossible thing; and indeed, this notion of a Deluge seems to be so extravagant, that I can scarce think that any body will be so credulous as to believe it; and yet it is impossible that it can be any other ways, if we suppose all the Mountains of the Earth to have been cover'd with an Ocean of Water, of no greater dimensions than that assign'd in the Theory, which cannot cover more than the three and twentieth part of the Earths surface.

The *Defender* in vain alledges, that we are to conceive this Ocean as a mighty rushing Sea, overflowing and iweeping with its Raging waves and Impetuous Fluctuations, all the Mountains; for this will not at all take away the absurdity, because motion can never multiply any body, nor make it to be at more places than one at a time. Water can only by motion be in many places successively, which will give us the Idea of such a moving heap or Mountain of waters, as we have just now prov'd impossible. Nor is this notion of a Deluge agreeable to the principles of the Theory.

Theory. For let us suppose the Crust to have been broken by the force of vapours endeavouring to expand themselves, it must immediately fall down and drive the Water of the Abyſs out of its place, ſome one way, and ſome another; this Water will aſcend with a very conſiderable force, let us ſuppoſe as far as five Miles perpendicular height, after which it will deſcend again and fall to the ground; and all this will be by computation in much leſs time than one day. Theſe waters having acquired a great force by their fall, will deſcend very ſwiftly into the Vallies and Cavities of the Earth, and leave both Mountains and Upper-grounds quite uncovered. And as the Waters that were raiſed by the fall of the Crust, could cover no more than a twenty third part of the Earths ſurface, ſo it is evident it could remain but a very ſhort time upon the tops of thoſe Mountains it overflow'd; whereas in *Noah's Deluge*, all the Mountains of the Earth lay under water for the ſpace of 150. days. Thus I have prov'd, that the Deluge the *Defender* endeavour'd to explain, is neither conſiſtent with the holy Scriptures, true Reaſon and Philoſophy, nor the Principles



Principles of the Theory, from whence he pretends to deduce it.

*Of the Figure of the Earth.*

**T**HO' what the *Theorist* has said in relation to the Figure of the Earth, be one of his grossest and most palpable errors, and tho' there is a positive demonstration that it is of a Figure directly contrary to that he assigns, yet his *Defender* thinks himself oblig'd to maintain it, and therefore spends more time and paper about it, than upon any other point.

He is not contented with what has been said by several Mathematicians and Philosophers of the present Age upon this Subject; tho' one would think that they knew the methods to determine the Figure of the Earth much better than either the *Theorist* or himself. He is afraid that they will give it against him, and therefore he appeals from them to some farther Observations, that He and the *Theorist* point out and direct us to make. As to observe for instance, whether the extent of a degree be the same in different Latitudes, or whether the

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shadow of the Earth in a total Eclipse of the Moon be truly round; as also to observe if towards the Poles, the return of the Sun to their Horizon be according to the rules of a Sphærical Surface of the Earth. These are the Observations the *Theorist* would have made to determine the controversy. Which I will now consider, leaving the *Defenders* Observations to be examined in a proper place.

I noted in the Examination, that I did not think any Observations that could be made upon different measures of a Degree in different Latitudes, could be so nice and exact, as would be necessary to determine the point in controversy. For supposing that the greatest Diameter of the Earth were to its least as 101. to 100. by which one Semidiameter would be very near 40. Miles greater than the other; (a difference which his friend who was so kind as to write him a Letter, thinks to be much too great) and then the greatest Degree upon the Meridian, would be to the least very near in the same proportion; that is, it would be 1 part of 100. greater than the other; but this difference is so very small, that I believe no Observations

vations in order to this discovery, are nice enough to be rely'd upon. For where the length of a Degree in Miles is determin'd either by the resolution of many right-lined or Spherical Triangles, it is scarcely probable, that the errors in Observations and Measuring, will amount to less than  $\frac{1}{3}$  of a Mile.

Tho' therefore we can scarce hope of ever attaining to a knowledge of the Earths Figure by measuring of it, yet to satisfy the *Theorist* in this matter, I took notice of one Dr. *Eisenschmidt*, who compares the magnitude of Degrees observ'd in different Latitudes, and finds that they are greater at the Equator than at the Poles, and that they gradually decreased from the Equator towards either of the Poles; from which he infers, that the Earth is of such a Figure as the *Theorist* has assign'd to it, whereas I following the *Theorists* principles, demonstrated that the Earth must have another Figure, and that the Diameter of the Equator must be greater than its Axis.

But our *Defender* says, that my demonstration proceeds upon a supposition, that the *Vertical Lines* or the *Lines of Gravity* (I suppose he means the Lines of direction of heavy Bodies) are to be

drawn directly to the Center. Does not the *Theorist* admit of the same supposition? Does not he make the Water descend from the Poles to the Equator, that it may be so much nigher to the Center? Since therefore according to the *Theorist*, the Lines of direction of heavy Bodies are towards the Center of the Earth, and (if we proceed upon that Hypothesis) where the Degrees are greatest, there the Earth must have its Diameter greatest, it will evidently follow from *Eisenschmidt's* Observations, that the Earth must not be an oblong Spheroid but a broad one, and have its Axis shorter than the Diameter of its Equator.

Our *Defender* tells us, that Dr. *Eisenschmidt* supposes the Vertical Lines or Lines of Gravity; to be drawn at right Angles to the Tangent of each respective Horizon. What Dr. *Eisenschmidt* does really suppose I know not, but I am sure he cannot suppose a thing more absurd than what our Author makes him suppose in this place. For that the Line of direction of heavy Bodies is at right Angles with the Tangent of the Horizon, is to me such an incomprehensible supposition, that I shall excuse my self from considering of it, till the *Defender* (who

(who I suppose would have us think he understands it) is at leisure to explain it.

I have not seen Dr. *Eisenschmidts* own Book, to know upon what principles he proceeds: It is said in the *Acta Eruditorum*, that he embraced the *Theorist's* opinion about the Figure of the Earth; and I believ'd that therefore he would also follow his and the common opinion, that all heavy Bodies tend toward the Center of the Earth; because it seems most reasonable, that the direction of heavy Bodies should be towards the Earth's Center of Gravity, which we may suppose to be the same with its Center of Magnitude. Nor can we suppose this direction to be any ways chang'd, but upon the account of the centrifugal force, that all Bodies in the Earth have acquir'd by being turn'd round the Earth's Axis. Now if he had taken the Centrifugal force into his consideration, he must have concluded (as I have done) that the Earth had the Diameter of its Equator greater than its Axis, which is still contrary to the conclusion he made. So we see, that whether this Author supposes the direction of heavy Bodies to be towards the Center of the Earth, that then by Observations he must have

concluded, the Earth to have been of a broad Spheroidical Figure; or whether he supposes the Lines of direction of heavy Bodies to be chang'd by a Centrifugal force, he ought to have drawn the same consequence from thence, tho' not indeed from his Observations of a degree measured in several Latitudes.

The *Defender* not daring to trust much to his own skill in this matter, has obtain'd a Letter from a Gentleman of his acquaintance concerning it. But all that Gentleman's reasons depend on a supposition which the *Theorist* cannot allow, *viz.* That the Tangents of the Ellipse are in the Horizontal Plane; whereas it is evident, that according to the *Theorist's* Hypothesis, these Tangents can never represent the Horizons, for he makes the Water to run from them down to the Equator: now it is certain that Water will not run if it be placed upon an Horizontal Plane; and if we are to make Water run any way, we must always make its Channel inclined to the Horizon.

This Gentleman indeed reasons truly, provided the Lines of direction of heavy Bodies were always perpendicular to a Plane, touching the Spheroid in  
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the point where the Body falls ; but as I have already observ'd, this supposition is not to be admitted by the *Theorist*, and we can no more suppose a Plane touching a Spheroid to be the Horizon of the point where it touches, than we can suppose a Man who stands upon the side of a Hill, to have that plain for his Horizon which touches the side of the Hill in the point of his station.

Thus, I think I have plainly prov'd, that there is no certain way to determine the Figure of the Earth from the observations of a degree taken in several Latitudes ; yet I have shew'n, that if either the *Theorist* or his *Defender* will depend upon those observations which are already made ; we must conclude from their own principles by evident demonstration, that the Earth is of a very different Figure from what they assign it.

The next way the *Theorist* would take to determine the Earth's Figure, is by its shadow upon the Moon : But it is easy to prove this way as uncertain as the other. For let us suppose (as we have done already) that the greatest Diameter of the Earth is to its least, as 101. to 100. (which is a much greater proportion than what is allowed either by

Mr. *Newton* or Monf. *Hugens*) because by observation, the Diameter of the Earth's shadow, is three times the Diameter of the Moon, and the Moon appears under an Angle of 30. minutes, therefore the Diameter of the Earth's shadow seen at that distance, will appear under an Angle of 90. minutes or a degree and half; and therefore if we suppose the Diameter of the shadow to be divided into an 100. equal parts, (the whole appearing under an Angle of 90. minutes) every one of these parts will be seen under an Angle of  $\frac{22}{100}$  or  $\frac{2}{10}$  parts of a minute; that is, in our present case, one Diameter of the shadow will appear under a greater Angle than the other, by  $\frac{2}{10}$  parts of a minute. Now by experience we find, that any object that appears under an Angle that is less than a minute, is seen as if it were a point. It is therefore plain, that if there were a Lucid Body whose Disk is large enough to receive the whole shadow of the Earth, that we could observe no sensible difference between the length of its Diameters; but if this Lucid Body had its Disk but just big enough to receive a  $\frac{1}{3}$  part of the Earth's shadow, (as it really is in the Moon) it is most evident



dent that we could not determine the Figure of the shadow near so nicely, as in the former case. We see then that by the Earth's shadow upon the Moon, its Figure is not to be determin'd with any tolerable exactness.

The third observation the *Theorist* would have us make, is about the return of the Sun to the Polar parts of the Earth, whether that be according to the rules of a Spherical surface. But this method is as little to be rely'd upon as any of the rest. The various refractions of the cold and thick Atmosphere, make all observations that are made there, very doubtful and uncertain: Besides, the Latitudes of those places that are near the Poles, are not exactly determin'd, so that there is no trusting to observations that have been already made, and I believe no body will go now to these places and Winter in them, on purpose to make new and more exact observations to determine this controversy.

The *Defender*, having thus pointed out the *Theorist's* own observations, comes now to consider the arguments that are brought by those, who say that the Earth is of a broad Spheroidical Figure. He tells us, that the learned Mr.

*Hugens*

*Hugens* thinks it may be prov'd by experiments made about the different Vibrations of a Pendulum in different Latitudes; and brings an instance of an experiment made at *Cayen* in *America*, where it was observ'd, that a Pendulum Vibrating in a second is shorter than one at *Paris* that performs its Vibrations in that time; from which he says, he concludes that Gravitation is less under and near the Equator than towards the Poles, and from thence, that the Figure of the Earth is protuberant and rises in the middle, its shortest Diameter being betwixt Pole and Pole.

We see here that our Author ascribes the observation about the Figure of the Earth, drawn from an experiment of Pendulums to *Monf. Hugens*, whereas it was *Mr. Newton* who first made the discovery, from whom *Mr. Hugens* had it; and this Writer in justice ought to have ascribed it to its true and genuine Author. But this is not the first time that the honour of several noble Inventions, which the World owes to that excellent Geometer and Philosopher, has been given to others.

The *Defender* tells us, that there are several things to be considered before  
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we come to the conclusion; first the matter of fact, concerning the inequality of Vibrations of equal Pendulums in different Latitudes; and then the inferences made from that inequality. As to the matter of fact, he tells us, that it was Mr. *Richer* who made the experiment, whose Person or Character he does not know, or whether his relation be extant in Print. 'Tis strange, that the *Defender* thinks that no body is to be trusted in a Philosophical experiment; but those whose Persons and Characters he knows. Has he such an universal acquaintance, as to have an exact knowledge of all those who are fit to make Observations and Experiments in Natural Philosophy? Certainly he must think, that the Gentlemen of the Royal Academy are better Judges of that than he is. *Monf. Richer* was chosen by them, and sent at the command and charges of the *French King*, to make Observations in the South parts of the World; and doubtless, when these Observations were to be made by order, and at the expences of their King and Patron, they would never choose any but one whom they knew to be well qualify'd for such an undertaking. And *Monf. Richer* himself  
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has justify'd the judgement of those that chose him, by his excellent Observations, both Astronomical and Physical, that have been so well receiv'd by the Learned. Among the rest, he gives us an account of this Observation about the Pendulum very exactly; He tells us, that during the ten months he stay'd at *Cayen*, there scarce passed a week in which he did not make the Observation, and found it always the same.

Monf. *Vaun*, Monf. *Hayes*, and Monf. *Du Glofs*, were also chosen by the same Academy, and sent to the Island *Goree* in *Africk*. They had it particularly in their instructions, to make Observations about the Pendulums; which they did, and confirm'd the Experiments made by Monf. *Richer*. We may see a particular account of all their Observations in the *Receuil des Observations faites in divers Voyages per l'ordre de sa Majesty*, in fol. Printed at the Royal Press in *Paris*.

To all this we may add, that the ingenious Mr. *Halley* when he went to *St. Helena*, (having first fitted the length of his Pendulums for Vibrating seconds at *London*) found afterwards that length at *St. Helena* to be too great; and therefore he was forced to shorten it, that it might

might Vibrate seconds there; tho' he did not then observe the exact difference between them. These repeated Experiments I hope will put the matter of fact past all doubt.

But (says our Author) even *Monf. Hugen*s speaks dubiously of the Experiment. This I deny; for *Monf. Hugen*s never in the least doubted of the Experiment, *viz.* That a Pendulum Vibrating seconds at the Equator, must be shorter than a Pendulum performing its Vibrations in the same time at *Paris*; for he has given evident demonstration that it must be so. *Monf. Hugen*s only doubted whether *Monf. Richer* had observed exactly the difference of their lengths; being fully assured in the mean time that there was a difference, as will be plain to any body that will be at the pains to read his Book. The reason why he doubted if *Monf. Richer* had given us the exact difference was, because he found that the difference observ'd by him, did not answer the numbers he brought from his own Calculation, which proceed upon a supposition that Gravity at all distances from the Center is the same.

But it seems the *Defender* does not see the

the consequence which is drawn from thence, *viz.* That Gravity must be less at the Equator than at the Poles, and therefore wishes, that it were prov'd by other Experiments. It is strange and surprizing, that this Author should know exactly how the Earth was made, by what Principles and Laws of Mechanism the World was framed, how the Deluge overspread the World, and what way the Mountains arose, and yet should be ignorant of so plain and easy a peice of Mechanism as this, which has not the hundredth part of the difficulty or intricacy of those which he pretends to know. Well, to convince him I will here repeat the demonstration somewhat plainer than I did in the Examination.

Let us suppose two bodies moving in two equal Cycloids; it is demonstrated by Mr. *Hugens* that the time of the descent thro' these Cycloids, is to the time of the descent thro' the Axis of the Cycloids always in a given proportion, *viz.* as the Semiperiphery of a Circle is to its Diameter; and therefore if the time of the descent or vibration in these two equal *Cycloids*, should be unequal the time of the descent thro' their *Axes* will be also unequal. Now the *Axes* of the  
the

the Cycloids being equal, and the time in which the Bodies move thro' them, unequal, it is evident that the two forces which move these two Bodies must also be unequal; that is, the accelerating force of Gravity in the one, will be greater then the accelerating force in the other; or which is the same thing, (supposing the Bodies equal) the *Conatus* that the one has to go downwards, will be stronger than the *Conatus* that the other has to go downwards, that is, the Gravity of the one will be greater than the Gravity in the other.

Now this is the very case in hand; for we find by the Observations of Pendulums, that a Body Vibrating in a Cycloid here, will perform its Vibrations in shorter time, than when it Vibrates in the same Cycloid at the Equator; and therefore it is a demonstration that the Gravity at the Equator is not so great as it is here. Which if the *Defender* had well understood, he needed not to have troubled himself about the making of other Experiments, since there can be none that are more nice than this. For tho' the difference of time for one single Vibration be very insensible, yet this difference being often repeated, will

come at last to be very sensible, and by observing it for a longer time, we may come to as great exactness as we please.

From this we may conclude, that there can be no experiments made which will more nicely determine the different Gravities at the Equator and here, than what is to be done by observations from Pendulums; and that no body will speak against such Experiments, but they who do not understand them. But however we will now consider the Experiments the *Defender* would have made to examine the different Gravities here and at the Equator.

He tells us, he would not have it made by a Balance or Scales, but by such powers as do not immediately depend upon Gravity, as Springs or other Engines, Rarefactions, or whatsoever has the force to raise, sustain, or remove, ponderous Bodies. But how does this Author know, but these Springs and Engines may change their force also at the Equator, and so be able to raise no greater weight than they will do here. Has not the weather a very great effect upon the Elasticity of all sorts of Springs, which it alters according to the dryness or dampness of the Air? And can we be sure



sure that the same Spring in so different Climates and seasons, will preserve the same Elasticity? But granting that Springs would not alter their Elasticity in different Climates and seasons, yet the difference between the Gravity here, and that which is at the Equator is so small, (the one being to the other as 690. to 689.) that the difference of their effects would be scarce sensible. For let us suppose that a weight here extended a Spring to the length of an inch, the same weight would not draw it out so far at the Equator, by  $\frac{1}{690}$  of an inch; which quantity is so small, that we should need good Microscopes to perceive it.

The next Experiment the *Defender* would try, is that of the Barometer; for he thinks the *Mercury* should sink much lower there than with us, or indeed, to nothing if the height be comparatively so great as is supposed. It is hard to conceive, why the *Mercury* should sink lower at the Equator than it does here. I cannot suppose he concludes so, because it is lighter there than here; for upon that account it ought to rise higher; neither can I suppose that he thinks it ought to sink, because the Air is not so

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high

high there as here; for the Air turns round the Earths Axis as well as other Bodies, and therefore it must have a Centrifugal force as the rest have; and where this Centrifugal force is greatest (which is under the Equator) it will rise highest from the surface of the Earth. Since then we can see no way by which he can prove this paradox, we must leave it, and desire him to make it out in his next Book.

There are some other Experiments, that the *Defender* would try to know the exact Figure of the Earth; as for instance, He says, "the height of the Equator should make a different Horizon (as "to the Heavens, or the Earth and Sea) "East and West, from North and South, "the Figure of the Earth being a Sphere "one way, and a Spheroid the other, the "Sea also must be seventeen miles deeper "at the Equator than at the Poles. Then "in reference to Rivers, the motion of "those that rise near the Equator must be "swift and rapid, but very slow must the "motion be of those that ascend to it, if "at all they can be suppos'd to climb so "great a Hill.

"The great River of the *Amazons* rises "five degrees from the Equator, yet runs "up

“up to the Equator with a vast load of  
“Waters. *Rio de Nigro* has a longer course  
“against the bent of the Earth, and cross-  
“ing the Equator falls into the Southern  
“Sea. The *Nile* in *Africk* crosses the Line,  
“and has a long course on this side of it.  
“Rivers do not rise higher by a natural  
“course than the Fountains head, and  
“Hydrographers do not assign above two  
“foot in a mile for the descent of Ri-  
“vers: but upon this Hypothesis, there  
“will be fourteen or fifteen foot for every  
“mile in Rivers descending from the E-  
“quator; which is a precipitation rather  
“than a Navigable Stream. Suppose (says  
“he) a Canal cut from the Equator to the  
“Poles; it would be a paradox to say,  
“that water would not flow in this Canal  
“having fourteen or fifteen foot descent  
“for every mile; but it would be a great-  
“er paradox to suppose, that Rivers  
“would rise to the Equator, and with  
“the same celerity as we see they do up-  
“on an ascent of so many feet.

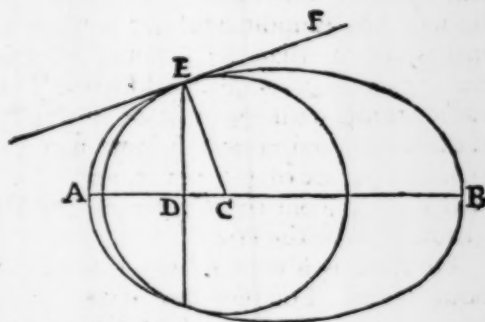
These are the *Defenders* thoughts on  
this subject: it is scarce imaginable how  
any one should be so forward in defend-  
ing the Theory, that appears so intirely  
unacquainted with Natural Philosophy,  
as this Author does. However, if it be

not too late for him to learn, I will do what I can to inform him, and consider what he has said.

His first thought, that there should be a different Horizon, as to the Heavens, the Earth and the Sea, East and West, from North and South, the Figure of the Earth being a Sphere one way and a Spheroid another, is such unintelligible language as would puzzle a Mathematician to imagine, how it were possible for a man to put such words together, with a design to mean any thing. But however, if I may humbly guess at what this incomprehensible Gentleman intends; I suppose he would say that the Section of the Earth is a Circle one way, and an Ellipsis the other.

Now I can easily demonstrate, that if the Earth were a Spheroid, any point of it would have no other Horizon than what some would have a Sphere, whose Axis is in the Axis of the Ellipse; thus, Let A E B be an Ellipsis, E F a Tangent to it in the point E, to which erect the perpendicular E C meeting with the Axis in C at the Center C, and the distance C E, describe a Circle; it is plain, that this Circle will be touched by the straight line E F in the point E, and if both the Ellipse and  
Circle

Circle were turned round the Axis AB there would also be a Spheroid and a Sphere generated; both which would have the same Plane touching them in



the point E, because the periphery of a Circle whose Radius is DE would be in both their surfaces, and the Ellipsis and Circle touch one another in the point E, that is, because the Horizons at E are supposed to be in the Plane which toucheth the Spheroid and Sphere in that point; both these Figures will have the same Horizons. The same thing is demonstrated of any other point.

As for his other thought, *viz.* That the Sea ought to be seventeen miles deeper at the Equator than at the Poles; he

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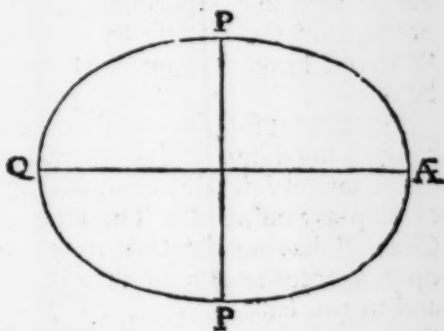
would

would have done well to have offered us some of his abstruse reasons why it ought to be so, for a common Reader, that is not used to his profound way of thinking, cannot easily perceive any, for he will not suppose without any arguments for it, that the Channel of the Sea is exactly of a Spherical surface, but rather think with the rest of mankind, that it is raised after the same manner that the surface of the Sea is, and is further distant from the Center at the Equator than at the Poles.

His next is a very strange thought about Rivers. For (says he) if the Earth were of a broad Spheroidical Figure, and if we should suppose a Canal cut from the Equator to the Poles, it were a paradox to say, that the water will not descend from the Equator to the Poles; but it would be a greater to suppose, that Rivers would rise from thence to the Equator. Well, if this be a paradox, I hope he will thank me if I teach him how to solve it.

For the greater ease and clearness, let us suppose the matter of the Earth first to have been fluid. If this matter had no Centrifugal force, it would settle itself into an uniform smooth (tho' Spherical)

rical) surface; but the Earth being turn'd round its Axis, and all the parts of it by this rotation acquiring a Centrifugal force, and those at the Equator having a stronger force to recede from their Axis than those towards the Poles; it is evident, that the fluid at the Equator would rise no higher than that towards the Poles, and the fluid would settle its self into a broad Figure; as is here represented, where,  $\overline{A}Q$  represents the Diameter of the Equator,  $PP$  its Axis.



Now this being the Figure which arises from the force of Gravity joined with the Centrifugal force, it is evident, that as long as these two causes continue to act, this Figure will remain the same, and the fluid will not alter its position

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nor

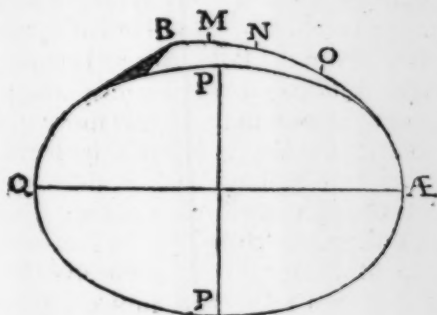
nor descend from  $\text{Æ}$  to  $\text{P}$ ; but that cause which first brought it into such a posture, will always preserve it in the same. Or if we should suppose this Figure alter'd or chang'd by any external force, so that the Diameter of the Equator was made shorter; it is evident, that as soon as this external force is taken off, that the fluid being acted by the two already mentioned forces, will immediately restore its self into its former natural figure; and the parts of the fluid will never come to an equilibrium one with another, till they settle so as that the Spheroid have the same surface it had before.

Let us next suppose this fluid Spheroid to be chang'd into a solid one, all except one Channel extended from  $\text{Æ}$  to  $\text{P}$ , and as deep as you please: The fluid in this Channel having the same forces to act upon it, according to the same direction, and in the same manner, will still keep the same position, without ever changing its figure, and every part will remain in the same place that it was in before; it being indifferent to the fluid in the Channel  $\text{ÆP}$  whether the matter next it be fluid or not fluid, solid or not solid.

By this, I hope it will appear no paradox



radox to say, that if a Channel were cut from the Poles to the Equator, that the water would not run from thence down in this Channel to the Poles. I will next make it appear no paradox, to say, that water may be made to run from the Poles to the Equator. It is well known, that (whatever be the Figure of the Earth) water will not run from the Land to the Sea, except the Land be raised higher than the Sea, and be made to incline to it. Let us therefore suppose that  $BMNO\text{Æ}$  were the surface of the Land raised higher than the Sea, but always inclining to it till



it meets with it in  $\text{Æ}$ . It is plain, that whatever water is at  $B$ , will endeavour to approach to the surface  $P\text{Æ}$  as much

as

as it can, and settle it self there in its natural figure; and because the point M is nearer to the surface P  $\text{\AA}$  than B, the water must move from B to M, but the point N being nearer to the surface into which the water does naturally affect to settle it self; it is evident, that this water will likewise move from M to N; after the same manner and upon the same account, would the water move from N to O and from O to  $\text{\AA}$ , it still coming nearer to the surface upon which it would naturally spread it self, that is, it would move from the Poles to the Equator. Thus, I hope I have made it manifest, that it is no great paradox to say, that the water will move from P to  $\text{\AA}$  or from the Poles to the Equator. I have insisted more largely upon this point, that it may appear more evident to the *Defender*; because it seems he cannot understand such reasonings, unless they are made very plain; for I had said the same things in the Examination tho' somewhat more obscurely.

Before I leave this subject, I cannot but observe, that tho' our Author perhaps is very well acquainted with the Antediluvian Geography and the rise of its Rivers, yet it seems that his skill  
is

is not very great in the modern. For he makes *Nile* in *Africk* to cross the line, whereas if he had consulted the modern Geographers and their observations, he had seen that the *Nile* rises some degrees on this side of the line, as it is to be seen in *Ludolphus's* Map of *Aethiopia*.

After this fine discourse of our Authors about the ascending of Rivers towards the Equator, to conclude the argument he says, that if this difference of Pendulums were found, it will still bear a dispute from what Physical causes it proceeds. He indeed may dispute it, and perhaps will never come to know it as long as he lives, but I believe very few else will ever doubt, but that it proceeds from a greater Gravity in the one place than there is in the other; especially since it can be prov'd from demonstrative principles, that if there be two Pendulums of equal lengths that perform their Vibrations in unequal times, that the Gravity where the swiftest Pendulum Vibrates, is greater than where the slowest is. This I say can be demonstrated from most evident and Geometrical principles; and if the *Defender* does not understand them, it will be his wisest course to suspend his judgement till he has learn't

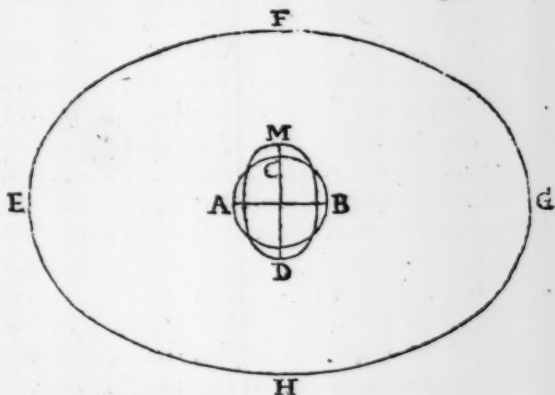
learn't as much of the Elements of Geometry and Mechanism, as will qualify him to comprehend them.

I not only prov'd this variation of Gravity, from its effect upon Pendulums, but I also shew'd the cause of it, and that it must be so, upon supposition, that the Earth turns round its own Axis. For all Bodies that turn round an Axis, endeavour to recede from that Axis; and because at the Equator Bodies moved swiftest, the Circles there being greatest, this *Conatus* or Centrifugal force would be also greatest; now this force at the Equinoctial acting directly against the force of Gravity, (which it does nowhere besides) it is evident, that upon this account Gravity must be less there than any where else. Upon the account of this diminution of Gravity it must follow also, that the Diameter of the Equator will be greater than its Axis, or that the Matter at the Equator rises higher than at the Poles.

The *Defender* says, that this is agreed and own'd on all hands, in case there were no impediment to hinder the rising or retrocession of the middle parts; but (says he) the *Theorist* did believe, that the Vortex was of a shorter Diameter there than

than thro' the Poles, which hindred the rising of the fluid. What this impediment is, or what should occasion this straitness of the Orb at the Equator I know not; I hope the *Theorist* does not suppose that there is a great iron hoop at those parts, a solid ring like that of *Saturns*, which keeps in the fluid from rising. Yet how it should be else kept in is beyond my skill to guess; I wish he would explain this more at length, that we might know what he means by it.

But let us suppose this straitness of the Orb at the Equator, and see what will follow from it; Let A C B repre-



sent the Earth, first of a Spherical Figure: EFGH a fluid Orb of Air which surrounds

surrounds it, which we will suppose straiter at F than at E and G; Let A B be the Axis of the Earth, because the matter of C has a greater endeavour to recede from the Center than the matter any where else upon the Earth; it is evident that this matter must press stronger upon the fluid immediately above it, than the matter at other parts can do upon the fluid immediately above them; and because the matter of the Earth is much more solid than the fluid Air, it is plain, that the *Vis motrix* or absolute force that the matter of the Earth has to recede from the Center, will be greater than the absolute force that the Air has to recede from its Center; it is plain upon this account, that the Air must yeild to it; but according to the *Theorist* the Air cannot rise higher than F, therefore it must recede towards E and G, and leave room to the matter at C to rise up to M; by which means it is evident, that (this matter thus rising at the retrocession of the fluid Air) the solid matter of the Earth must settle its self in the form of a broad Spheroid. Thus, from the *Theorists* own principles and suppositions, I have prov'd that the Earth must be higher at the Equator than at the Poles.

The

The Author tells us, that those who affirm that the Earth is in form of a broad Spheroid, will allow of no *Vortices* to the Planets; but then (says he) they must assign some other sufficient cause to carry the Planets in their Periodical motions with the same velocity for innumerable Ages about their common Center; and the Secondary about the Primary; as also what gives them their diurnal rotation, and the different position of their *Axes*.

I thought that this *Defender* had been better acquainted with the history of Philosophy for these twelve years past, than it seems he is. One would think that he had done nothing but por'd upon the Theory all this time, since he is not acquainted with what is known to every body that pretends to Philosophy now a days.

He may find several hundreds of people that can tell him, that there are other causes found for the Coelestial motions than the *Vortices*, which will easily explain all those *Phænomena* he has just now mentioned. The causes why the Planets move in Elliptical Orbits are now discover'd; it is known why they move swiftest at their *Perihelia*, and slowest

slowest at their *Aphelia*. The cause of the proceſſion of the Equinox is now no longer a myſtery; and (which is for our purpoſe) it depends upon principles that ruine the *Theoriſt's* Figure of the Earth, and aſſert the direct contrary, making it in the form of a broad Spheroid.

The motion of the Moons *Apogee* forward and of its *Nodes* backwards, its variation, and all its other motions, are eaſily accounted for by the ſame cauſes, none of which could ever be made out by the *Vortices*. For by them we can't answer the firſt queſtion the *Defender* puts, *viz.* What is it that carries the Planets round the Sun with the ſame velocity for many Ages? Nay, ſuppoſing that we were altogether ignorant of any other cauſe, yet it is no hard matter to prove, that the *Vortices* can never be the cauſe of the Coeleſtial motions; and therefore there being no *Vortex*, there can be no ſuch thing as a ſtraitneſs in the Orbit at the Equator, which the *Theoriſt* and the *Defender* ſuppoſe. But if I ſhould allow them both their *Vortices* and the ſtraitneſs of their Orbs, I have already prov'd, that they will ſignify nothing to their purpoſe.

The



The *Defender* tells us, that this reasoning about the Figure of the Earth depends upon the *Theorists* Hypothesis, that the Globe of it was once fluid; and from thence he pretends to confirm the Theory: For (says he) *neither Figure of the Earth, oblong or oblate, can be proved from the rotation of the Earth and its Gravity, without supposing the Globe formed into that shape before it came to be hardened, before it came to be loaded and stiffened with Rocks and stony Mountains; and therefore upon both Hypotheses it must be allowed, that there was such a time; such a state of the Earth when its tender Orb was capable of these impressions and modifications, and that Orb must have lyen above the waters not under them, nor radicated to the bottom of them; and in the last place, this concretion upon the waters (says he) must have been throughout all the parts of the Earth, for there is no reason why one part of the fluid should be covered more than another; so (says he) that in effect we must suppose, that all the watery Globe was at first covered over with an Earthy concretion: Now this being admitted (says he) we have confirmed the main point of the Theory, namely, that the Abyss was at first covered over with an Orb of earth; and if we will*

*grant him this he will compound for the rest.*

He is a little too unreasonable in expecting grants of such things as are altogether precarious, and affirm'd without so much as a shew of an argument. My business was to prove, that he had deduced a wrong conclusion from his own Hypotheses and Principles; and therefore, supposing that the Globe of the Earth was once fluid, I prov'd from thence, that it must have settled it self into the figure of a broad Spheroid, and not of an oblong one.

But yet I demonstrated, that supposing the Earth to have been partly fluid and partly dry, as it is at present, that even in that case, the Figure of the Earth must be Spheroidical, because we observe that the Land is very nearly of the same Figure with the Sea, (only raised a little higher, that it may not be overflowed) and composes with it the same solid, but the Sea being fluid will settle its self into just such a figure, as if the whole Globe were fluid, that is (as I have demonstrated) its surface will be the same with that of a broad Spheroid; and therefore the Land which is of the same figure will be so likewise. And thus I hope I have prov'd, that whether we suppose

suppose the Earth to have been at first intirely fluid, or to have been compos'd of parts some solid and some fluid, that from either of these suppositions it follows, that the Figure of the Earth must be directly contrary to what the *Theorist* assigns.

But (says our Author) if the Earth was from the beginning in this present form, firm and solid, (as it is now) Rocky and Mountainous, then the question is, how the Parts or Regions of the Earth about the Equator, could be raised above a Spherical figure or into an oblate Spheroid; suppose then the waters raised by the circumvolution of the Earth, how was the *Terra firma* raised, or how could it be raised by that or any such cause. These questions (says he) are no matter of difficulty to the *Theorist*, who supposes the first Earth to have covered the Waters, and to have taken their shape (whatever it was) as upon a mould.

However easy they may be to the *Theorist*, I assure him that they are much easier to me, who suppose that God Almighty raised the Land at the beginning, when he form'd the Earth into the Figure it has at present, which otherwise could never have risen of its self.

The dry Land therefore was rais'd and formed into a Spheroidical Figure by its wise Creator, on purpose that it might not be overflow'd by the Sea at the Equator, which (as I have prov'd) must of necessity have been higher there than at the Poles; and therefore if the Land at the Equator had remain'd in a Spherical Figure, no higher than that which is at the Poles, the Sea must of necessity have risen above it, and spread its self upon it like an Inundation. It was therefore wisely order'd by the Divine Providence, that not only the Sea but the Land also should be form'd into a broad Spheroidical Figure, on purpose that it might not be overflow'd with Waters.

That the Readers might observe the *Theorist's* great skill in drawing of consequences, and how well his Oval-figur'd Earth was supported with reasons; I gave them his argument thus, *All bodies by reason of the Earths diurnal rotation, do endeavour to recede from the Axis of their motion, but by reason of the pressure of the Air, and the straitness of the Orb, they cannot recede from the Axis of their motion, therefore they will move towards the Poles where they will come nearer to the Axis of their motion, that is, Because all bodies endeavour*

deavour to recede from the Axis of their motion, therefore they will endeavour to go to the Axis of their motion. In answer to this, the Defender says, that the Theorist asserted, that all Bodies did *conari à centro sui motus recedere*, which I have render'd, endeavour to recede from the Axis of their motion; and by changing the word Center into Axis, of plain sense (says he) I have made non-sense; and then he is so free as to own, that the conclusion will follow from my own words, but not from those of the Theorist. I own, that I chang'd the word Center into Axis, not carelessly but willfully, with a design not of making it non-sense, but better sense than it was before. For we never say that a Sphere turns round about its *own* Center, for that would be plain non-sense indeed, but round about its *own* Axis; for we cannot so properly say, that a Body moves round a Center as round an Axis, unless we abstract from its Magnitude, and conceive it as a point. The reason is plain, for when any Body revolves, it is evident that every point of it which does not lye in the Plane of another points Orbit, must describe a different Periphery, which must have also a different Center, so that

all those Centers are placed in one line, which is therefore call'd the Axis of the Bodies motion; about which, Bodies are said to revolve much more properly than about a Center: however, this Author says, that by changing the word Center into Axis, of plain sense I have made non-sense. This Gentleman seems to be so extreemly paradoxical, that I have often suspected he must have a different method of judging what is sense or non-sense from other people, if he has it, it were but fair to shew it, that we may know when things will be agreeable to his *Criterion*, or when they will not; if he thinks it non-sense to say, that Bodies do endeavour to recede from the Axis of their motion, it is my comfort to have some good Mathematicians on my side, who think otherwise: I need only mention one of them, whose very name is enough to defend me, *viz.* The greatest Geometer and Philosopher of the Age, who uses this way of speaking very often in his *Philosophiæ Naturalis principia Mathematica*, for which he needs go no further than page 8. where it is said, *Gyrantium partes omnes conantur recedere ab Axe motus.*

But however, let us reassume the word  
Center,

Center, and see if the argument will appear more plausible, or seem to conclude better than it did by using the word Axis: *All Bodies by reason of the Earths diurnal rotation, do endeavour to recede from the Center of their motion, but by reason of the pressure of the Air and the straitness of the Orb, they cannot recede from the Center of their motion, therefore they will go towards the Poles, and move in a Circle where they will be nearer the Center of their motion.* I hope I have not now chang'd his words, but have deliver'd his true meaning; I leave the Reader to judge if it is not excellently well concluded, and if the connexion be not so evident, that it needs no Comment to make it out.

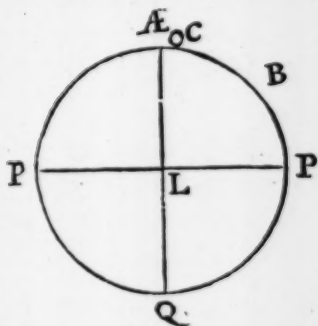
Now supposing, that the *Theorist* had reasoned well all this time about the Earth, and had deduced its true Figure from its true causes; yet I demonstrated, that all this will not make Rivers run from the Poles to the Equator, for a reason that I will take the liberty here to repeat, that we may compare it with the *Defenders* answer; The demonstration is this:

The Rotation of the Earth round its own Axis being still the same, the cause

which thrust the water from the Equator to the Poles, will also continue the same and invariable, and by consequence it will hinder the water from returning again towards the Equator; and therefore, supposing that the Earth was formed into an Oval-figure, yet there could not be any course for the Rivers; for only so far would the water ascend towards the Poles till the force which protruded it that way, came to be in *Equilibrium* with its Gravity, and there it would stop, neither ascending farther or descending again, as long as the same cause continu'd to act; that is, so long as the Earth turn'd round its own Axis in the space of twenty four hours. But if the Earth should cease to move round, then indeed, in that case and no other, would the water return to the Equator. For let the figure P  $\text{Æ}$  P Q represent the Earth, P P the Poles,  $\text{Æ}$  Q the Equator, B a body upon the surface of the Earth. I think it is evident, that the body B will so far ascend towards the Poles, till the force that protrudes it that way, be in *Equilibrium* with the force that draws it to the Equator. For if at B one were greater than the other; for example, the force which draws it towards the Poles, were



were greater than its gravity or its tendency towards  $\text{Æ}$ , then it would still move towards the Pole, till both forces come to act equally, and there it would rest as long as these two forces continued in *Equilibrium*, which must be so



long as the Earths diurnal motion lasts; now whatever Bodies either solid or fluid, are brought and lay'd upon the surface of the Earth at B, these being drawn or pusht with the same accelerating force either to the Polé or to the Equator, that the first fluid had which was constituted at B, the same causes continuing to act upon both, they will rest there also, and consequently will not descend to the Equator.

The *Defender* thinks he has transcrib'd  
this

Pag. 55,  
56.

this reason very briefly thus; *The same causes which cast the Abyss or the Ocean towards the Poles, will also keep the Rivers from descending from the Poles; and then he answers, that there is no parity of reason betwixt the Abyss or the Ocean, and the Rivers. We see (says he) in the flux and reflux of the Ocean, it hath not that effect upon Rivers nor upon Lakes, nor upon lesser Seas, yet the circumrotation of the Earth continues the same: He adds, That my confounding the Ocean and Rivers in the Antediluvian Earth is so much the worse, seeing there never was an Ocean and Rivers together in that Earth; while (says he) there was an open Ocean there were no Rivers, and when there were no Rivers there was no open Ocean, but an inclosed Abyss; He concludes at last, That tho' I make large transcripts there and elsewhere out of the Theory, yet I do not seem always to have well digested the method of it.*

I hope the Reader will observe how unfairly this Author is pleased to deal with me, for in all the argument I have not so much as once mentioned the Ocean: but the demonstration was universal and reach't all sorts of Bodies, whether they be in the Abyss or on the surface of the Earth. My words were,  
that

that whatever Bodies either fluid or solid, if brought and lay'd upon the surface at B, being drawn or pusht with the same accelerating force, that the first fluid had which was constituted at B, the same causes continuing to act upon both, they will rest there also, and not descend to the Equator. Where is it now that I have confounded the Ocean with the Rivers? Or is there any thing in these words, by which it appears that I have not digested the method of the Theory? There is one of this Authors acquaintance, that is pleas'd to tell us, that dissingenuity in examining the Writings of another Person falls more heavy in the construction of fair Readers, upon him that uses them, than upon him that suffers them: If it be so, this Gentleman may easily know, what these Readers will think of him.

*Reflections  
pag. last  
line last.*

However, it seems he thinks, that tho' none of the water return'd to the Equator while the Earth was at first fluid, and had put on its Oval-shape, yet when the first concretion was settled upon it, whatever water was after that upon its surface, would then descend towards the Equator. Why so I pray? What reason does he give for this? Had not the fluid

fluid which lay at B, the very same causes to keep it from descending to the Equator, that it had before, when the Earths surface was all fluid? Was not there the same diurnal rotation of the Earth, in the same time, and by consequence the same Centrifugal force? Was there not the same pressure of the Atmosphere, and the same straitness of the Orb that was before? And in a word, every thing the same that kept it from descending in the former case, would also preserve it in this in the same position, what reason then can this Author give us for this assertion? Indeed, he offers us none; if he has any, he keeps it as a secret, which it seems he will not communicate but to his friends. I think he will do well to keep it secret for ever.

But, tho' he will neither shew us his own reasons nor answer mine, yet that we may not be altogether dissatisfy'd, he is pleas'd to give us a similitude to explain it: "We see (says he) in the  
*Pag. 55,*  
56. "flux and reflux of the Ocean, (let the  
"cause be what it will) it hath not that  
"effect upon Rivers, nor upon Lakes,  
"nor upon lesser Seas; yet the circum-  
"rotation of the Earth continues the  
"same.

"same". Is there any parity of reason here between the flux and reflux of the Sea, and the descent of the fluid to the Equator? Or does he think that the flux of the Sea arises only from the rotation of the Earth? If he had study'd true Philosophy but half so much as he has done the Theory, he might have known that the Tides of the Sea are caused by the action or attraction of the Moon upon it; and because one part of the Ocean (being directly under the Moon) is more attracted by it than the rest, the Ocean there must swell, and the water will run from the other parts of it, unto the place which is most attracted. Now in Rivers, Lakes, and narrow Seas, there being no difference of attraction in any of its parts, (they being all so narrow that the Moon cannot act stronger upon one side of them than the other) it is plain, that no part will swell more than another, and the waters will not rise higher, nor move from one place to another, by reason of this equal attraction.

Perhaps, this may be a little obscure to this Author, who as it seems does not understand the true cause of our Tides; but it not being my business to explain these

these things at large, I will refer him to an excellent discourse of Mr. *Edmund Halley's*, which he made to K. *James*, when he presented him Mr. *Newton's* Book of the Principles of Natural Philosophy.

He tells his Reader that I ought to have given a better notion of *Centrifugal force* than what I have done; For he quotes Page 110. of the Examination, where it is said, that the Centrifugal force or that force by which a Body is drawn towards the Center; and in the next Page it is said, that by this Centrifugal force Bodies endeavour to recede from the Center of their motion, which is true, but contrary to what I said before.

He needed not have gone so far as the 22<sup>d</sup>. line of the next page, to have found out the true notion of a Centrifugal force; for if he had repeated the words immediately following his first quotation, he might there have found it. But if he had done so he had lost his aim, and the Reader would have perceiv'd that it was not a confusion in my notions, but only a fault of the Press. I will here repeat the sentence, that the thing may be set in its true light, *If a Body (said I) revolve freely in a Circle about a Center,*

*a Center, as the Planets do about the Sun, its Centrifugal force, or that force by which it is drawn towards the Center, will be always equal to its Centrifugal force by which it doth endeavour to recede from the Center.*

A candid Reader would have immediately imputed this to nothing else but a fault in the Printing, and instead of the first word *Centrifugal force*, he would have seen that the word *Centripetal force* ought to have been put, as the very sense would easily have directed any one that had the least acquaintance with this subject.

After this the *Defender* tells us, that I might have spar'd what I have transcrib'd from other Authors, about calculating the diminutions of Gravity made by the Centrifugal force in different Latitudes, these being needless to the confutation of the Theory. Why so I pray? Are they not to the purpose? Or do they not answer the intended design, which was to find out by a Calculus the difference of Gravity in different Latitudes, and from thence to confirm our Hypothesis, by comparing Calculations with Observations, and seeing how the one agrees with the other? Well, but I am blam'd for transcribing them from  
other

other Authors. I hope he does not think them the worſe for that; or that I ought not to make uſe of them as arguments againſt his Theory, becauſe they were ſaid by others. He might indeed have juſtly blam'd me, if I had publiſhed them as new notions or inventions of my own, and told the World *I expected thanks for the discoveries*, as a late Author has done; but I pretended to no ſuch thing.

It is well known that Mr. *Newton* was the firſt that made the diſcovery, and ſhew'd the method of Calculating the Gravity of Bodies at different Latitudes, whom therefore I mention'd as the ſole Inventor. Mr. *Hugens* indeed I did not name, ſeeing he had the notion intirely from Mr. *Newton*, as that learned Gentleman does freely acknowledge. But after all this, I have not ſo much tranſcrib'd from theſe two learned Authors, as I have endeavour'd to explain their notions, and make them intelligible to Men of lower capacities.

Thoſe two excellent and learned men, had ſomething elſe to do, and matters of greater concern to mind, than to publiſh their diſcoveries at large, ſo that every Reader might underſtand them. I thought there-



therefore that it would not be altogether displeasing to the World, if I endeavoured to explain their Theorems about the Figure of the Earth, and the effects of Gravity join'd with a Centrifugal force; so that they might become intelligible to those who understand the Elements of Geometry and the common principles of Statics: and I doubted not but it would be more acceptable, because there has not (at least to my knowledge) been any discourse published of this nature in *English*.

Without doubt the Reader does now perceive, how vain, empty, and incoherent, a piece of Philosophy this Theory is; its principles are false, suppositions precarious, and the reasonings upon them, are all along so weak and ill grounded, that it is hard to think that the *Theorist* himself can give any credit to it; and yet (which is strange) he professes that he believes it more than he does the *Mosaick History* of the Creation; tho' there is this great difference between them, even supposing no inspiration in the case, that there is nothing in the account that *Moses* gives, but what is really possible; for according to him the whole was perform'd by the immediate

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hand

hand of God Almighty, who needs not the help of second causes for such a work; whereas the *Theorist*, who would have it arise from Natural and Mechanical principles, always assigns such causes as are utterly insufficient for the proposed effect, and generally such as would really produce the contrary.

But if after all, the *Theorist* will still insist upon the truth of his Theory, and has no mind to prove it himself; I would advise him to find out some new *Defender*, who can understand, and consider the force of an argument somewhat better, than his last seems to have done, who (as it appears) has not so much defended the Theory, as expos'd its nakedness and his own unskillfulness.

However, since the *Theorist* has such a high opinion of his own performance, and so mean a one of the account given us by *Moses*; before I end this discourse it will not be amiss, to Examine a little the notion he has given (in his *Archeologie* Book II. Chap. 8, 9.) of the *Mosaic History* of the Creation. Which in short is this, That we are not to believe the first Chapter of *Genesis* in a literal sense; but that *Moses* receded from the *Physical verity*, as he calls it, and spoke only

only *λαοδογματικῶς*, that is in plain *English*, there is not a word of it true, the World being neither Created nor Formed in the manner there recorded; but that his History of the Formation of Heaven and Earth was not contriv'd to be agreeable to the truth, but to the notions and dispositions of the people for whose use it was written.

*Archeol.*  
p. 317.

To make this out, he pretends to find many faults and incongruities in that History, which I need not now particularly consider; since there is none of them that is really incongruous and disagreeable, either to the Nature of things or the Wisdom of God, but only to his notions, and ways of thinking: As for instance, when he says (and he tells us that he speaks it with indignation) that without the greatest reproach both to the Work and its Maker, it is neither to be said or imagined, that this Earth which he stiles the very dregs and excrements of nature, should be the chief and principal part of the Creation, and the first born of every Creature, so that there should be more time allow'd for the framing and ordering of it, than what is bestowed on all the rest of the World.

*Archeol.*  
p. 299.

However great the *Theorist's* indignation is, that he has conceiv'd upon this account, I am sure there are some that cannot read those Reflections of his upon this History, without a much greater. It may be suppos'd that *Moses* who had an immediate conversation with God Almighty, knew better what was a reproach to the World and its Maker than the *Theorist* does, and yet we find that he thought it no affront to the Divine Wisdom, not only to say and imagine such a thing, but also to write it, and that with a design, that it should be received as true by all future generations.

*Archeol.*  
p. 318.

But says the *Theorist*, the Sacred Writers do often speak in a Mystical, Allegorical, or Metaphorical stile, and according to the capacity of the people, and why might not *Moses* do the same in delivering the History of the Creation. To answer this, let us consider in what cases the Scriptures are to be taken, not in a literal but in an Allegorical and Metaphorical sense, and then compare each of them with the present case, to see if there is any parity of reason between them.

First then, the Scriptures are to be understood in an Allegorical sense, when  
their

their literal meaning would imply a contradiction, either to some other place of the Sacred Writings, which is most evidently to be understood literally; or to the nature of the things spoken of; thus when God Almighty is said to have hands and feet, ears and eyes, to move and walk, and to have the affections and passions belonging to Men, all or any of these since they are a contradiction, to the Infinite perfections of the Deity, can never be understood in a literal meaning; tho' there should be still some sort of analogy between them and the thing signified. We are sure, that this consideration can have no place in the *Mosaick History* of the Creation, which most certainly does neither contradict any other part of the Scriptures, nor is there any thing said there but what is plainly possible, and can be performed by the Power of God, who if he had pleas'd, could have formed the World or any part of it (how great soever) in an instant.

In the next place, the Scriptures are not to be taken in a real and literal meaning, when they speak according to the system of appearances, and the notions which we draw from our senses;

K 3

Thus,

Thus, when it represents the Earth plain, and as having four Corners, with the Heavens stretched over it like a Curtain. In those indeed, and in many other such like places of Scripture, it is certain, that it was the design of the Sacred Pen-men, not to speak according to the reality and nature of the things themselves, but according to the notions and opinions which people received of them from their senses; or indeed when the Sun is said to move every day from East to West, to Rise and Set, to stand still, there is no necessity of imagining that all those things are really perform'd by the Sun; but there the holy Pen-men, as all other Writers which do not concern themselves with Astronomy, speak according to the system of appearances, and as the Heavenly motions are represented to them by their senses, it being the common and receiv'd way of speaking from which we are not to recede, if we design to be understood; and even all those Astronomers who firmly believe the motion of the Earth, when it is not their business to explain the true system of the Universe, are forced to speak in the same Dialect: and I believe we should scarce think a Man right in his wits,

wits, that in writing or speaking upon any common subject, instead of saying that the Sun rose or set, or that it came to the East or went to the West of us, would say, that our Horizon moved till it came above the Sun or went under it, or that our Horizon turned round till the East or West points of it came to be exactly under the Sun.

Now this can never be apply'd to the *Mosaick History* of the Creation, since the method of the Formation of the World could never have appeared to our senses, and without a Divine Revelation, we should have been ignorant of it to this day, and had never discover'd the order and method by which all things were form'd. *Moses* certainly wrote that discourse on purpose to give us a true notion of the Creation, and therefore was to speak of things as they were really formed, without any respect had to appearances as they would be represented to humane senses; since there was no Man then in being to whom they could have appeared, and I am of the opinion, that if he had purposely and directly wrote as much, upon the System of the World and the motions of the Heavens, as he has done upon the subject of

the Creation, all those who acknowledge the Divine Authority of his writings, would have been oblig'd to believe it.

The next case, wherein we are to recede from the literal sense in the interpretation of Scripture is, when they deliver parables; those being only contriv'd by their Writers to illustrate something wherein they would instruct the people, can never be suppos'd to be understood in a literal meaning.

This way of writing is indeed very ancient, and is of great use for informing Mankind in the precepts of Prudence and Morality, which are never so easily retain'd, or so strongly imprinted on our imagination, as when they are couched under some Fable, whose Moral is easily apprehended. But then from the nature of those Parables, and the manner of their delivery, it is easy to perceive, that their Authors never design'd they should be receiv'd as true History; all their aim was, that we should attend to the Moral, for the sake of which the Parable was contriv'd; this is plain from the Parable of *Jotham* of the Trees choosing themselves a King, and from all the Parables of our Saviour.

But



But the History of the Creation is a very different case from any of them; *Moses* does not give it us as a Fable, only contriv'd for the sake of some Moral meaning which he would have thereby understood, but delivers it seriously as matter of fact, which he would have us believe as firmly and truly as any other part of his History; and this a Man of integrity could never have given himself leave to do, had he not been satisfied that the History was exactly true.

But if the *Theorists* Hypothesis about the *Mosaical History* of the Creation were true; it seems that *Moses* must have been guilty of imposture in a very high degree, for he supposes that History to have been absolutely false, and without any foundation in the reality of things, and at the same time freely owns, that *Moses* wrote it with a design that it should be receiv'd as true, not by one Man only, but by a great and populous Nation, and that not for one Generation, but through all succeeding Ages; this I take to be strange doctrine, and no ways agreeable to the high esteem we owe either to that great Prophet, or to the Veracity of that unerring Spirit that assisted him in writing.

But

Pag. 320,  
321.

But it is the *Theorists* opinion, that *Moses* thought it necessary to give the *Jews* a *Cosmogonia*, a Theory of the Earth, each of their neighbouring Nations (as he guesses) had one of their own, which were generally erroneous and inconsistent with the true Religion; and if so, some of them might have had his Theory for ought we know; now he thinks, that without doubt the *Jews* had taken one from them, or had made one for themselves, unless they had been otherwise provided by *Moses*; he illustrates this with a very decent similitude, if you do not get a Husband for your Daughter, she will find one for her self, your Foot-man perhaps, or some one as mean.

*Si nuptiam non dederis  
filiam ipsa sibi maritum  
queret e famulis forsitan  
aut humilis plebe.*

Well, but since the *Jews* were to have a *Cosmogonia*, why should they not have been taught the true one? O says the *Theorist*, that was by no means fitting, for they were an ignorant, indocible people, and could never have been taught true and solid Philosophy, such as his own Theory is; For let us feign says he, at least (and 'tis but feigning at best) that our Theory is true, let us suppose the Primitive Earth to have been made

made in the same form and manner as is describ'd in the Theory; had not *Moses* spent his time well in teaching such Philosophers? Can we suppose that those Brick-makers, those who still smelt strong of the Onions and Garlick of *Egypt*, those who could not distinguish a Molten Calf from God Almighty; can we (says he) suppose, that ever they could have learnt the true principles of things, or the Laws of nature and motion? to have deliver'd those things to them, would have been to cast Pearls before Swine.

The *Theorist* may have as great thoughts of his Theory as he pleases, but it is my humble opinion, that there is very little skill required, either in the Laws of motion or Natural Philosophy, to understand it, as well as he himself does: there is no necessity of a long proof for this, since we are sure there are some, that have not only Read it, but even stood up in the Defence of it, that seem to understand as little of real Philosophy, and less of Mechanicks, than the most ignorant of his Brick-makers.

Let us now assume the same liberty with the *Theorist*, that he has done with *Moses*, and let us suppose that the *Theorist* should.

should get a Congregation of *Jews*, who I believe are still as dull as ever they were, and should begin to Harangue them thus.

Be it known unto you Men, Brethren, and Fathers, That this Earth which we now press with our feet, and find so firm and solid under us, was once a fluid *Chaos*; that is (that I may adapt my discourse to your low capacities) a medly, or a confused Mass of Earth, Water and Air, mixed and blended together: How it came to be so, or how long it continu'd in that state, I know as little as you do; only I am sure that it was once so, and I would have you take my word for it; at last, this disorderly Mass came to settle, and all Bodies took their place according to their weight, the great heavy Bodies fell lowest, and compos'd the innermost solid; next to them the Water took its place, and over it the Oil spread it self, above all there was a huge thick Orb of Air, full of mud and earthy particles, those by degrees fell down upon the surface of the Oil, and at first made a thick slime, which thro' time began to harden, and compose a firm and solid Crust, over the face of the Waters; that was able to sustain

sustain the weight of all the rest of the descending particles.

What deep reach of thought is requir'd for the understanding of this? How many, and what are the Laws of nature and motion that the *Jews* must know before they can comprehend it? in my mind the less they knew of those things, the fitter they would be to understand the Theory; at least, I am sure they would be more easily perswaded to believe it. We see now that this way of reasoning as the *Theorist* has apply'd it, is of no force against the *Mosaic History*, for his refin'd Theory if it had been true, might have been as easily comprehended by the *Jews*, as the plain and simple *Cosmogonia* of *Moses*.

The *Theorist* perhaps may think, that I have here and elsewhere treated his Theory with too much contempt and disdain; but let him consider how meanly he himself has spoke of some of *Moses's* writings, with how much scorn and derision he has rejected his History of the Creation; let him think how plainly and openly he has ridicul'd the state of Innocence and the Fall of Man; let him compare what he has said in the 7th. 8th. and 9th. Chapters of his *Archeologia*,

*logia*, Lib. II. with the hardest Expressions in this discourse against his Theory, and I am confident he will find no reason to complain of uncivil usage.

His *Defender* 'tis true, accuses me of hard words and coarse language, in saying *that's false, that's absurd, that's ridiculous*; whereas most of the Philosophers have been forced to use the same expressions, insomuch that they became Philosophical terms, and (till the *Defender* began to write so smoothly) Men were never accounted rude and uncivil for using of them. Nay, the *Theorist* himself has been sometimes pleased to deliver himself in the same manner, and I am sure that he has handled the writings of some excellent Men with more severity, than his Theory has met with from me.

His rude treatment of *Aristotle* may be a sufficient testimony of this, whose Philosophy he never mentions but with the greatest contempt and scorn: Tho' the works of this Philosopher have been honoured with the general commendations of all the Learned thro' so many Ages, and are still justly valued by those who have the greatest reputation either for Polite or Philosophical Learning;  
His

His discourses upon Rhetorick, Poesy, and Politicks, his Logick and Ethicks, are deservedly admired as Master-peices in their severall ways; and tho' his Physiology is not without errors, yet I am sure that there is more true Natural Philosophy in his Mechanical questions alone, than in all the Theory. But if some sort of Philosophers are not acquainted with the true value of this Author, yet the general reception that he has found in all the Universities of the Christian World, might one would think, have secured him from the rude insults of any private Writer.

However, the *Theorist* is not satisfy'd with exposing this great Man and his Philosophy as they come in his way, but in order, as he thinks to make him more contemptible, has given us a short View or Catalogue of his errors, If I should do so with him, and set down a Collection of all the errors that may be found in his writings, they would I am afraid, tire the Readers patience, and make a Folio almost as big as the Theory.

At last, he takes his leave of *Aristotle* in those very civil terms, *Vale Stagyrita semper mihi eris malus Astronomus, Theologus pejor, Physiologus pessimus.*

It

It were easy for me if I design'd to be ill natur'd, to change the word *Stagyrita* into *Theorista*, and then take my leave in the very same form; but tho' I think the *Theorist* far inferiour to *Aristotle*, yet I am not for parting with him in so rude a manner; I acknowledge him to be an ingenious Writer, and if he had taken a right method and had made a considerable progress in those Sciences, that are Introductory to the study of nature, I doubt not but that he would have made a very acute Philosopher.

It was his unhappiness to begin at first with the *Cartesian* Philosophy, and not having a sufficient stock of Geometrical and Mechanical principles to examine it rightly, he too rashly believed it, and thought that there was but little skill required in those Sciences to become a Philosopher, and therefore in imitation of *Monf. Des Cartes*, he would undertake to shew how the World was made, a task too great even for a Mathematician.

All that I now desire of him, is to spend some time in the study of Numbers and Magnitude, Astronomy and Staticks, that he may be the better able to understand the force of my Arguments against his Theory, after which I doubt not but that



that he will easily perceive its errors, and have the ingenuity to acknowledge them. But till then, all further disputation between him and me, must needs be vain and frivolous, since true reasoning in Natural Philosophy depends on such Principles as are demonstrated in those Sciences, the knowledge of which he has not yet attained.

*FINIS.*

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A  
DEFENCE  
OF THE  
REMARKS

Made on

Mr. Whistons *New Theory*.

**I**N my Answer to the two *Theorists*, I endeavoured to shew, that neither of them had lit upon an Hypothesis which would solve the *Phænomena* of the Creation and the Deluge, according to the Mosaick History; and that the schemes they had drawn, might be confuted by their own principles: I thought, all that could be expected from me was, to shew, that both of 'em were unlucky in the choice of their main Hypotheses, and unskilful in the management of them.

But Mr. *Whiston* in the first Paragraph of his Vindication, has surpriz'd me with a new distinction between an *Hypothesis* and a *Theory*, and tells me, That in a

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Theory, (such as he desires his should be thought) *Wit and Skill are qualifications not necessary, and very little to be considered therein.* If this be allowed, all Theories are unanswerable: But upon presumption that every body is not of his opinion, I shall persist in making good my first Objections against him.

As to the account he gives of the Origine and Progress of his Work, the Persons and opportunities that were conducing to it, I can only say, it shews too great a fondness for his Theory; and 'twas scarce worth his while to trouble his Reader with such minute relations about it, especially after it was, as I presume, already confuted. But however, since I have read this History of its Birth, I am less surpriz'd at the mistakes I meet with in it; since that *very Learned Friend* of his, upon whose judgement he seems chiefly to rely, (for I dare venture to say Mr. *Newton* wont engage for the truth of all his Theorems) has given the World reason enough to suspect him, none of the shrewdest Judges of that part of Learning.

After Mr. *Wh.* has duely inform'd his Reader, by what steps and methods he accomplish'd his wonderful performance,

he tells us, That it is a little surprising, that I of all men should in publick appear against him. His Reader may think, by this way of speaking, that there lay some special Obligations on me to be silent, tho' I declare I know none; I never enjoy'd the happiness of Mr. Whiston's acquaintance, and therefore cannot guess, what it is that should oblige me more than any other, to forbear publishing Remarks on his Theory. 'Tis true, I did and allways shall respect and honour him, as a Learned and Ingenious Man; but I hope he does not think, that upon this account I ought to have suppressed all Objections against his Philosophy. He seems to be of opinion, that it was my duty, privately to have communicated my difficulties to him by a Letter, and not to have taken this publick method of writing Remarks on the *New Theory*. I declare, I am altogether insensible of such a duty, and I don't think, that I have transgressed the rules of civility by what I have done. It is commonly thought, that whatever any one publishes is submitted to the judgement of its Readers, and any one of them may take the same liberty in publishing Remarks upon it, that its Author did at first in

proposing it to the World: And since I am perswaded that my Objections against the *New Theory*, are at least, as strong and convincing as his Reasons are for it, I cannot see, why out of a complement to Mr. *Whiston*, I should suppress them.

Mr. *Whiston* says, that I am deeply engag'd against his design, thro' a peculiar fondness I seem to have for unaccountable Miracles. If I had a mind to criticise upon words, I would ask him what he means by unaccountable Miracles, and whether there be any that can be accounted for, since it is the common opinion, that what can be accounted for by natural causes, is no Miracle. However, I know no Miracles I am fond of, save those mention'd in Scripture; and at present I am only engag'd in the Defence of two of them, *viz.* The Creation and the Deluge, and a fondness for them seems not to be peculiar to me; since till this Age of World-makers, Christians have always thought them such works, as could never be produced by the Laws of Nature and Mechanism.

I know indeed that there are some, who are not only for explaining the above mentioned, but even most of the other extraordinary events recorded in the

the holy Scriptures, by natural principles: But I dare suppose Mr. *Wh.* would not willingly be put into a Catalogue with such Authors. I could, and I think with just reason too, tell him, that if he had not a peculiar fondness for his own Theory, he would easily perceive, that all those things which he endeavours to deduce from Mechanical principles, are not to be explain'd by such causes. But I am willing to pass by his preliminaries, and enter upon his argument.

I first objected against the *New Theory*, that the Chaos, which was the origination of our Earth, could not have been the Atmosphere of a Comet, since the one is represented as a dark caliginous Body, having darkness on the face of its Abyss, and the other was a transparent fluid, and was enlightned, if not from its own Central Body from within, yet at least by the Sun from without. To this he Answers, that Comets cannot be changed into Planets till their return from the vast and cold Regions beyond *Saturn*; and he says, that we need not think that they will be then so vehemently hot, that they must be light also. If what he says in another place is true, I cannot but still think, that they must

be hot to such a degree, that they will also be extremely Luminous; for according to him, the heat is so great even after their return towards the Sun, that all the parts of their Atmospheres are in a violent agitation, heavy and light, dense and rare, fluid and solid parts, are jumbled and mixed together in the greatest confusion, thro' the violence of the heat. This I think, is sufficient to make us believe them very lucid likewise. But says he, solids preserve some of their heat after their light is gone. But is it credible, that the heat of the Central solid should be so great as to preserve its Atmosphere, at the distance of some hundred thousands of miles, in a continual agitation, and at the same time not be light? Can we suppose that it will raise vapours into its tail to the distance of many millions of miles, and after all imagine, that it is not so hot as to be lucid? This I think would be as great a paradox, as any that is to be met with among the Philosophers.

It's known, that the intenseness of light and heat is always proportional to the density of Rays that produce them, and that this density, is in all places in a reciprocal proportion to the squares of the  
the



the distance of the Body, from which they proceed; and by consequence it is plain, that heat and light must be prodigiously stronger at or near the surface of the hot or lucid Body, than at a great distance from it; and therefore it is no wonder, if the heat of a solid be very sensible to a hand that is laid upon its surface; when the eye placed at a distance from it, cannot perceive its light. But let us bring this point into numbers, that we may see it more evidently. It follows from Mr. *Whiston's* own positions, that the heat of the Central solid must be so great, even before the Comet arrives at its *Perihelion*, as to act upon the Atmosphere at the distance of 10000. miles, and from thence to raise vapours into its tail for many millions more; and therefore the intenseness of its heat at that distance, must be to the intenseness of the heat at the distance of ten miles, for example, as the square of ten is to the square of 100000. miles, that is, as one to 10000000. If therefore the heat of the Central solid at the distance of 100000. miles, had any sensible effect upon its Atmosphere, it must be prodigiously stronger at the distance of ten miles, and therefore cannot be supposed to be without light.

He

He allows the Sun to shine thro' the Atmosphere of the Comet, whilst it remains such; But then upon the Commencement of the Creation, when it began to move in a Circular Orbit, it lost its pellucidness, and became a dark and opake fluid. How this should come to be I know not, nor can I discover, why upon the change of the Comet's Orbit from an Ellipsis to a Circle, its Atmosphere should be likewise changed on a suddain from a clear and transparent fluid, to a dark and caliginous one. Immediately before the change of the Orbit, even after it had descended from the cold Regions beyond *Saturn*, he allows its Atmosphere to have been so bright and diaphanous, as that the Central solid might have been seen thro' it. It must be then a miracle and an unaccountable one too, that could have caused such an immediate darkness.

It was also objected to him, that his dense and heavy fluid, could not be the Mosaical Abyfs; for it was at first dark, and afterwards enlightned, whereas his new Abyfs after it was once dark, never again became visible, being always covered with an opake Crust. Here he owns, that the word Abyfs is not to be  
restrained

restrained to his dense fluid, but that it comprehends all that heterogenous and hitherto muddy fluid, which was beneath the Earths future surface, where the Spectator in the Historical Journal of the Creation, is suppos'd to have been.

But I desire him to tell us, whither this muddy fluid was afterwards enlightened; whither the same collection of Opake and Earthy Corpuscles which produced a darkness on the surface of the dense and heavy fluid, would not create also a thick darkness upon the surface of the muddy one; whither this darkness would not continually encrease, as those Earthy and Opake particles came closer together, and when at last they fell upon, and inclosed this muddy fluid, and form'd a Crust (according to him) of 60. or 70. miles depth, whither they would not exclude the light from it for ever.

I had urg'd to him, that 'twas said in Scripture, *Darkness was upon the face* or the exterior surface *of the Abyss*, and that afterwards there was light upon it. Now if Mr. *Whiston* cannot shew us clearly an Abyss from his principles, whose exterior surface was first dark, and afterwards luminous, I hope he will grant that his Theory is not conform'd to the Mosaick History.

Another

Another Argument against the Theory, was to this purpose. If the Earth was form'd by the principles of Mechanism out of the Atmosphere of a Comet, we must allow the whole subsidence to be as leisurely, and to proceed by the same steps that the violence of its heat decreases, which would not then (as he would have it) be compleated in six Years, nor indeed in as many Centuries; and the Opake parts would take so much time in descending and composing the Crust of the Earth, that the Sun would always illuminate (at least the upper Regions of its Atmosphere) as freely as it does the whole Atmosphere of Comets, while they are within our Observation. He allows this to be an Argument of good force, and to deserve consideration; and he tells us, that if Comets were observ'd to have no Atmosphere after their return from the Regions beyond *Saturn*, before they arrive at their *Perihelia* again, then indeed this reasoning were unavoidable; but seeing the contrary is evident from Astronomical Observations, it cannot affect his Hypothesis. If he had deny'd any Proposition in my Argument, or any consequence drawn from it, I should have known what reply to have made;

made ; but I cannot apprehend how this Observation upon Comets does in the least affect my Argument, nor imagine to what purpose it was brought in here, but to amuse some thoughtless Reader.

He tells us farther, that the Laws, Properties, and Operations of Bodies, which we find established here on Earth, do not universally obtain in the Atmospheres of Comets. This I own to be an Answer, not only to this one Argument, but to all that can be said against his Theory. But may not any other Theory be defended at the same rate? Might not Dr. Burnet have maintained his Theory this way? And when it was objected against it, that heavy Bodies, such as Earth, Clay and Stones, could not swim upon Oil or Water, would it not have been easy for him to have said, that Bodies had then other Laws, Properties, and Operations, than they have now, and that it was at that time the Law of Nature, that the heaviest Bodies should swim uppermost, and the lightest fall to the bottom? Tho' one would think, that it were as impossible that there should be such a Law of motion, as that a Proposition in *Euclid* should be false. If the Laws of motion were arbitrary and changeable,

changeable, why should the Mathematicians pretend to demonstrate them as necessary consequences from their principles? Let us suppose a *Vectis* in one of Mr. *Whiston's* Comets, and two powers apply'd to its *Brachia*, upon which they act perpendicularly, so that the powers be to one another in a proportion reciprocal to the length of their *Brachia*. It is actually impossible but these two powers must act equally, the one against the other, or that one of them unassisted by any other cause, should be able to move the other against its direction: Since effects must be always proportional to their adequate causes. And yet, according to Mr. *Whiston's* position, this Law of Nature perhaps is only true in our Earth, and not in any Planet or Comet whatsoever.

By this Answer Mr. *Whiston* has granted me all that I design'd to prove, *viz.* That the Earth was not form'd according to the known Laws of Mechanism, but by the efficacy of the Divine Spirit which mov'd upon the face of the Waters.

It was said in the Remarks, that there is no need of a hot Central solid, to solve the origine of Springs, and such other *Phænomena* of nature; they being better accounted

accounted for by other means. To this it is answered, that the reality of an internal heat within the bowels of the Earth, is a matter of fact, and must be accounted for whatever becomes of Springs. I always allowed an internal heat, but thought it might be accounted for without a hot internal solid; and I refer him to what has been said upon this subject, in the Examination of the Reflections on the Theory.

Mr. *Whiston* thinks, that the account I refer to for the origination of Fountains is not so universal, as to stand in no need of subterraneous vapours; But since he has given us no reason for this thought of his, I need say no more to it, but that I think otherwise; I am sure it is evident by Calculation, that the Vapours raised by the heat of the Sun from the Sea, are alone sufficient to serve all our Rivers and Fountains with Water. And nature never makes use of two distinct causes where one would do; for then the effect would be greater than it ought to be.

I told him, that he receded without necessity from the literal sense, in supposing, that the formation of the Sun, Moon and Stars, mention'd in the first of *Genesis*, is to be only understood of  
their

their being made visible, and of their appearing to an eye placed in the Earth. But since he desires to know my reasons for this opinion, I must tell him, that his interpretation seems to be extremely forced, and no way agreeable with the design of the sacred Pen-men. *Moses's* narration is plain and simple, and throughout the whole, he does not affect to speak either Metaphorically or Allegorically; but he delivers it as certain matter of fact, which we are firmly to believe. He plainly mentions the Creation of the Sun, Moon and Stars, and makes the production of them a distinct days work by its self; In expressing their formation, the same word *וַיַּעַשׂ* (*and he made*) is used, that is found afterwards in the 25<sup>th</sup>. verse, where there is an account given of the production of beasts; and therefore *Moses* seems to have design'd that the word should be taken in both places in the same sense. Besides all this, it is certain, that *Moses* did not speak of things as they appeared, or would have appeared to an Eye placed in a muddy fluid, since there was no one then in being to whom they could have appeared.

From all these considerations, I think it evident, that it was *Moses's* intention  
to



to be understood in a real and literal meaning. I desire Mr. *Whiston* to consider what is said more at large upon this subject in the Examination of the Reflections on the Theory.

But after all, I do not see that Mr. *Whiston's* reasons prove any impossibility in *Moses's* account of the Creation; all that I think he proves in his long discourse is, that the plain and simple account that *Moses* gives us, is not agreeable to his Theory, to his way of thinking, or to the method by which he would have the World produced.

His Theory supposes, that the Sun upon the second day before it became visible, raised as many Vapours from the Earth, as were sufficient to fill all the Seas, Lakes, and Rivers, that were in the Primitive Earth. Here, I thought he assign'd a cause no ways proportional to the effect. For since the Sun even when it shines very strongly and directly upon our Ocean, does in a whole year raise but the thousandth part of our present Ocean into Vapour, how can it be supposed, that it could raise as much Vapour in that time, as would fill the Seas, Lakes, and Rivers, of our Primitive Earth, when all the while it was not visible, but

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obscur'd

*Vindic.  
pag. 9.*

obscur'd by a dark and thick Atmosphere, by which the power of its beams must be extreemly weakned. In answer to this, he tells us, That he does not suppose that all the Water that was in the Seas, Lakes and Rivers, of the first Earth, made above the thousandth part of our present Ocean, which he thinks might have been easily exhal'd by the Sun in one half year.

Now I would have him to consider this Objection a little further, and he will find that it is not so light as he imagines it is: he knows that there must be a certain proportion betwixt Land and Sea, that the ground may be sufficiently furnished with rains and dews: for the quantity of Vapour that is raised from Water, all other things being alike, is always in proportion to the surface of the Water, and if the surface of our Sea were, *for example*, but the thousandth part of what it is now, there would in that case be raised but the thousandth part of the Vapour from it, that is at present raised from thence; and because the dry Land by such a supposition would be near double of what it is now, it follows from thence, that any particular piece of ground would not have much above  
one,

one part of two thousand of the rains and dews it has at present. So that if this had been the case of the Primitive Earth, it must have been absolutely barren and unfruitful: But if that cannot be allow'd, it is evident, that there must have been a much greater Sea there to make it habitable, than what Mr. *Whiston* supposes.

But if after all the Antediluvian Sea had been form'd only by the raising of Vapours by the Suns heat for one half year, I do not see how it could have amounted to the ten thousandth part of our present Ocean. For it is known, that a few Clouds will more obscure the light of the Sun, and by consequence diminish its heat in the same proportion, than if nine in ten parts of its Disk were obscur'd by an Eclipse: however, I will only suppose, that its heat was but just as much diminished by the thick Atmosphere Mr. *Whiston* speaks of, (which had perfectly darkned and obscured his body for more than two years) as it would be in an Eclipse. where nine ten parts of its Disk were obscur'd; and then the number of Rays producing heat in any part, being but a tenth part of what they are now upon us, they would not raise above a

tenth part of the Vapour that could be raised by the free and open action of the Sun. But the Sun when it now acts upon us freely, raises not much above one thousandth part of the present Ocean into Vapours; therefore it is evident, that in the other case it could not raise much above the ten thousandth part of the present Ocean, and a Sea only formed from those Vapours, would be little better than none at all.

But allowing it possible in the manner Mr. *Whiston* contends for, allowing him too, that this small stock of Waters was sufficient for the necessities of the Earth; yet after all this way of forming the Primitive Sea is by no means agreeable to the account given us by *Moses*, *Where we are told, that God divided the waters which were under the Firmament from the waters which were above the Firmament, and the waters under the heavens he gathered together into one place, and the gathering together of the waters called he Seas.* But Mr. *Whiston* tells us, the Sea was made by those Waters that were raised into Vapour by the heat of the Sun, that is according to his interpretation, by the Waters above the Firmament, which is directly contrary to *Moses's* account, who  
says,

says, it was made by the gathering together of the Waters under the Firmament. It must be strange turning and wresting of words, that will bring both these ways to agree.

Besides, if the Sea were formed as the *New Theory* says it was, the dry Land must have appeared immediately upon the raising of the Vapours, whereas, according to *Moses*, it did not appear till after the formation of the Sea. It is plain then, that this Theory of the Sea given us by Mr. *Whiston*, is in every circumstance as inconsistent with the holy History, as 'tis with Reason and Philosophy.

Mr. *Whiston* acknowledges, that my reasoning against his third Hypothesis of an only annual motion of the Earth before the Fall, is strong and forcible, and therefore he has been pleased here to invent another Hypothesis to support the former, by which he hopes to remove all the difficulties that were raised against it; *viz.* That the Earth did not revolve in a Circular Orbit till after the Fall, but in a *moderate Ellipse*. I shall not trouble my self with new answers as often as he thinks fit to contrive new Hypotheses, and therefore will only give this reply at present, that it will scarcely

be allowed, that but one half of the Primitive Earth was habitable before the Fall, as it must be by such a supposition. We know, the more Hypotheses any Theory is clogg'd with, the more precarious it looks; such of them especially as do not naturally result from the whole Theory, but are only introduced to remove some urgent difficulty, are generally thought least of all to deserve any credit. One of the great Beauties of the Theory was, That as soon as the Comet was turned into a Planet, it had a Circle for its Orbit, and tho' this beauty is not perfectly spoil'd, yet its luster seems to be considerably diminished by the new supposition of his new sort of Figure call'd a moderate Ellipse.

Mr. *Whiston* is pleased to take notice of a supposed mistake, he imagines I have committed, about the quantity of heat in the Primitive Earth, which I reckoned from his principles, must have been some hundreds of times greater than what is in the present. This he says, *he is sure is a plain error*, who ever it was that made him so sure of it, I am certain they have mightily deceived him. If he had taken the pains to consider, that the heat of the Sun for any small portion of time  
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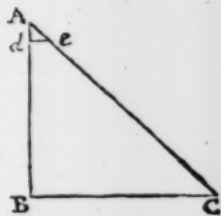
is always as a Rectangle, contain'd betwixt the Sine of the Angle of incidence of the Ray producing heat, and that time, and had troubled himself a little further to calculate the proportion of the quantity of heat that was in the Primitive Earth upon his Hypothesis, to that which is in our present Earth, he would have found the mistake was not on my side but his own. Every body knows, that the longer any thing is exposed to the heat of the Sun, the hotter it must be; and this is so manifest, that a great part of our heat in the Summer arises only thro' the length of time the Sun shines upon us. For if our Summer and Winter days were each of them twelve hours long, the heat in Summer would be to that in Winter, in proportion little more than three to one, (their difference in that case arising only from the more direct action of the Sun in Summer than in Winter) whereas, in the present case, our Summers heat is to our Winters heat in a greater proportion than that of seven to one.

It was objected against the *New Theory*, that a Comet coming near the Earth could not produce any tide in the Abyss below the Water, because it was closely

shut up by a thick and solid Crust, that pressed so close upon it as to leave no space, at least, not such a considerable one, as would make room for any considerable commotion of the Waters. In answer to this, he tells us, That he wonders how I come to imagine the Orb of Earth to be so compact and solid a Sphere, as to be able to overcome the great impulse the Abyfs would make upon it, at the approach of the Comet. We may easily conceive this to be no Argument, if we consider, that a tide is nothing else but a great agitation or commotion of the Waters, arising from the attraction of some great body placed near it; and because the velocity of the Waters produced by this attraction, is at first infinitely small, their force upon any other body must likewise be infinitely small in comparison of what it will be after the Waters have acquired a certain determinate velocity. For as in a heavy body its velocity or force by which it endeavours to descend, is at first infinitely small in proportion to that which it acquires in any determinate time; so here, if we suppose the velocity impressed on the fluid by the attracting body to be always in proportion



tion to the time, and at the end of any determinate time  $AB$  in which it has moved, it has acquired the velocity  $BC$ : After the first instant of time  $AD$ , its velocity was as  $de$ ; and because  $AB$  is infinitely greater than  $AD$ , it is plain from thence, that  $BC$  must be infinitely greater than  $de$ , that is, the force or impressed motion upon the fluid after it has moved in the time  $AB$  is infinitely stronger than it was in the beginning of its motion.



Let us now apply this to the case in hand; and in the present Figure let  $C$



represent the Central solid,  $ABDE$  the  
dense

dense Abyſs, F G H E the outward Cruſt lying cloſe upon it, and partly ſubſiding in it. This Cruſt Mr. *Whiſton* imagines to be 200. miles in depth. If the Abyſs had acquired any impulſe or velocity by motion, and by that force acted againſt the Cruſt, I make no queſtion but it would be able to break it and crack it into as many pieces as Mr. *Whiſton* pleaſes. But here there is no room left for motion, no vacuities, or void ſpaces; wherever the fluid is attracted, its motion will be abſolutely reſiſted, either by the fluid next, or a dense and ſolid Cruſt immediately contiguous to it. The ſmall cracks and fiſſures Mr. *Whiſton* mentions, would be abſolutely inconfiderable, and the motion in them could not be ſtrong enough to break or diſjoyn ſo thick a Cruſt, whoſe parts by their own weight, and their cloſe ſubſiding together, would be firmly compacted and united. Whatever the cracks and fiſſures were, which he imagines at firſt made by the Diurnal Rotation of the Earth, in the ſpace of 1600. years, they would come to be healed and made up, ſo that there would not be ſo much as one ſubſiding column that can be ſuppoſed ſeparate and diſjoyn'd from the reſt. And tho' we may  
ſtill

still suppose some small fissures in the Earth, yet he asserts that they were most in the Mountains; and therefore it is impossible that the Strata could be disjoyn'd and separated from one another by them.

All the effect that would follow from this attraction is this, Both the fluid on the Abyss and the Central solid would be attracted by the Comet; but the fluid on the Abyss being nearer to it than the other, would be more strongly attracted; and because the solid Crust by reason of the firmness and union of its parts, cannot move faster to the Comet than the Central solid does, it is evident from thence, that it must be pressed only by the difference of attraction, or by that force by which the fluid in the Abyss is drawn more towards the Comet, than the Central solid is; and seeing the fluid has acquired no velocity or impetus by motion, it is clear from what is already prov'd, and by what is more fully demonstrated by *Borell* in his 24. 25. and 26. Chapters of his Book *De vi percussione*; that the force of the fluid thus pressing, will be infinitely less than what it would be if it had acquired any determinate degree of velocity by motion.

motion. And since Mr. *Whiston* seems to acknowledge, that a great impulse of the fluid would be necessarily required to break and disjoyn the Crust, the small force arising from the pressure of the fluid, can never be able to produce so great an effect.

What Mr. *Whiston* says of a Floor of disjoyn'd Planks laid cross the Thames, that may as well be suppos'd to stop the Tide or the ascent of the Waters, as the Crust of the Earth the Tide of the Abyfs, is I think no parallel case. For it is not the attraction of the Moon that is the immediate cause of the Tide in the Thames; but it arises solely from the check and great impulse that the Waters receive from the motion of the Sea, by which they are driven backwards with violence, and are made to ascend up the River and produce Tides.

\* *Vindic.*  
pag. 17.

But if Mr. *Whiston* will still assert, that the Strata or subsiding Columns were separated and disjoyn'd like so many loose Planks, (tho' it contradicts what he has said in another place \*) yet granting that it was so, I shall from thence evidently demonstrate, that there could no Water arise upon that very account from the Abyfs or Bowels of the Earth, as  
shall

shall be shown in its proper place.

The *New Theory* supposes, that the fourty days rain mentioned in the History of the Deluge, was caused by the vast quantity of Vapours that were in the Comets tail, which being very much rarify'd and expanded, would immediately mount up again into the Air after their fall upon the Earth, and descend again in violent and outrageous Rains. Against this it was objected, that the incredible velocity with which these Vapours descended, and the great resistance they met with in their descent thro' the Air, together with the force by which they fell upon the ground, must of necessity have condensed them into Water. Here he answers, that tho' the greatest part of the Vapours should be condensed into Rain, yet 'tis hard that I will not allow many of them to escape the same, enough at least to make a constant fourty days Rain: for it is strange to him, that so thin a Body as our Air, lying in so small a compass about the Earth, should have the good luck to stop and condense all and every part of so immense and swift a descending Column of Vapours. As strange and hard as it is, yet I cannot see how its possible any should escape  
being

being condensed. If there were any void Canals in our Air thro' which some Vapours might descend, we might then allow him his Hypothesis; but since it is evident from the nature of our Air, that its impossible there should be any such empty spaces, it is certain, that there is not one of these Vapours but must meet with Air, wherever it moves in our Atmosphere, which it must therefore force out of its way; and because it is supposed to move so prodigiously swift as to descend 860. miles in a minute, the resistance it will meet with from every particle of Air must be vastly great, and must therefore necessarily condense it.

But if I should allow him that these Vapours were not condensed in their descent thro' the Air, yet to imagine that they should be not condensed when they fall with so prodigious a swiftness (as he allows them) upon the Earth, Water, or any other thing that will stop their motion, is such a fancy as needs no confutation: if they had such a strange velocity as he speaks of, they must penetrate and destroy all Humane and other Animal Bodies, so that such a shower as this one day, would have done the  
the

the business of a Deluge, and there would have been no occasion for other thirty nine days Rain.

But after all this, Mr. *Whiston* grants, that the Vapours might be condensed in their fall; but yet he says, that their heat which at first rarify'd them, and had continued their expansion in the Comets tail, would immediately after their fall, rarify them again, and raise them into new Vapour. But if so, I cannot see how this will answer the account that *Moses* gives us of the Deluge, For he tells us, that the encrease of the Waters was gradual, and produced in a great measure by forty days Rain; and that they continually encreased and prevailed upon the Earth for the space of 150. days: whereas by this Theory, the Deluge must have hapned all of a suddain; according to it, the very first day, all the Waters that came from the Comet must have fall'n upon the Earth, and by consequence the Waters that were raised from the Abyss, must have immediately ascended; so that if this Theory were true, the Deluge must be accomplished in one day and not in 150; for as to the Vapours which were raised and continu'd to fall for forty days, (unless  
the

the water was very scalding hot indeed) that would be very inconsiderable, and would rather diminish than encrease the quantity of Waters upon the Earth, untill they again descended in Rain.

I come now to consider the way Mr. *Whiston* raises the Fluid from the Abyss. He supposes, that the great weight of the Water which lay upon the Crust, would depress it and make it sink deeper into the Abyss, and by that means force and squeeze the Fluid thro' the fissures and cracks of the Earth. But against this I positively demonstrated, that no pressure of the Fluid whatsoever, could make the Crust sink deeper into the Abyss. In answer to this he is pleas'd to tell me, *That my demonstration supposes, either that not the water on the Earth but in the Fissures, did contribute to the raising of the Fluid thro' them, or that the several Columns had free liberty, and could subside as far as occasion should be, (which he has in his Book shewed they could not) or that a pressure from a Column specifically heavier than the Fluid, is necessary to raise it upwards.* Because Mr. *Whiston* answers my demonstration, as if he did not rightly understand it; I will here put it into a clearer light, and apply it more particularly to the present case. Let



Let ABCD represent the Fluid Orb of the Abyſs, EFGH the ſolid Cruſt ſwimming upon it, whoſe parts are ſeparated and diſjoined by cracks and fiſſures, *like ſo many looſe Planks laid croſs the Thames*, (and ſo indeed they muſt neceſſarily be, if the Diameter of the Abyſs



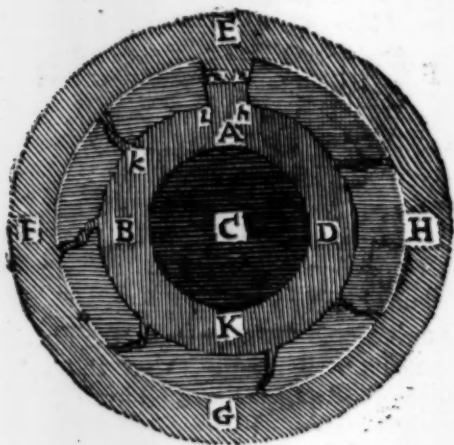
was enlarged ſixteen miles, as the Theory ſuppoſes) it is certain, that the looſe Cruſt will be ſo far immerſed in the Fluid of the Abyſs, or, which is the ſame thing, the Fluid will riſe ſo far up within the fiſſure, till the ſurface IK upon which the Cruſt lyes, is as much preſſed by the weight

N

weight

weight of the incumbent Column as the surface *ih* at the same distance from the Center, is by the weight of the incumbent fluid; that is, the fluid *mnih* must press as much upon the surface *ih*, as the solid Crust does upon the rest of the surface of the fluid.

Let us next imagine all this Crust overflowed with Water; and because Water cannot lye upon the Crust till the fissures are first intirely filled, the water must descend thro' them, and press upon the



surface of the Abyſs that lyes within them. Now if the preſſure of the water which lay upon *MN* the ſurface of the  
Abyſs

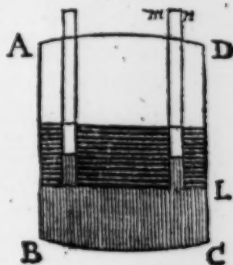
Abyſs within the fiſſure, were exactly equal to the preſſure of the water which lay upon the Cruſt, the ſurfaces I K and I H being equally preſſed, the parts of the fluid would ſtill remain in the ſame poſition. But here in this caſe the ſurface I H in the Abyſs being preſſed with a deeper Column of water than that which preſſes upon the Cruſt, the weight or preſſure of the water upon it, will be greater than the weight or preſſure of the water that lyes upon the Cruſt, and conſequently the ſurface I H being more preſſed than the ſurface I K, the fluid M N I H will deſcend further and raiſe the Cruſt higher, and it will more emerge out of the fluid; ſo that we muſt evidently ſee, that by the addition of this water, the Cruſt inſtead of being depreſſed lower will be raiſed higher.

Mr. *Whiſton* ſays, That *this demonſtration ſuppoſes that the ſeveral Columns of Earth had their free liberty, and could ſubſide as far as occaſion ſhould be, which he has ſhewed in his Book they could not.* It ſeems then that he owns, that the Columns would not ſubſide, if they had their free liberty, but if they had not their free liberty to ſubſide, then he thinks they would ſubſide or ſink deeper into

the Abyfs; that is in short, Those Columns would not sink deeper if there was nothing to hinder them, but if there was any thing that could hinder them from sinking deeper, then indeed they would, and must sink deeper. This is so strange and surprising a way of reasoning, that I scarcely believe it could have come from Mr. *Whiston*. It looks much more like the reasoning of *his learned friend*. I should have thought, that if he had been left to himself to argue the case, he would have concluded, that because the Crust could not sink deeper when it was left at its liberty, or when there was nothing to hinder it; It would have certainly so much the rather not sunk further, when there was an impediment.

I know but one possible case where the pressure of the incumbent fluid can make the Crust sink deeper into the Abyfs, and even in that case, I clearly demonstrated, that the fluid under the Crust could not be raised so high as to spread its self upon the surface of the Earth. But because Mr. *Whiston* has not taken any notice of this case, nor answered any thing to the Calculation that I had from thence deduced, I will here repeat it more clearly.

clearly. Suppose A B C D a Cylindrical Vessel half full of water, in which let there be put a wooden Cylinder, which is exactly adapted to the sides of the Vessel, so that no fluid can descend between the side of the Vessel and the Cylinder. It is evident, that if there were no holes in the Cylinder, it could not in this case be any ways depressed under the surface of the water; nor could it sink into it, if never so great an additional weight were lay'd upon it; but the Base of the Cylinder would lye immediately on the surface of the fluid.



Let us now suppose this Cylinder bored with holes parallel to its Axis, then indeed it would sink so far within the fluid, till the water within the holes came to be of such a height, as to press as strongly upon the fluid under them as the solid Cylinder does upon the fluid under it, and there it would rest at the height, for example, of half the Cylinder, if the water were twice as heavy as the wood. Let us suppose in the next place, that there were long Tubes

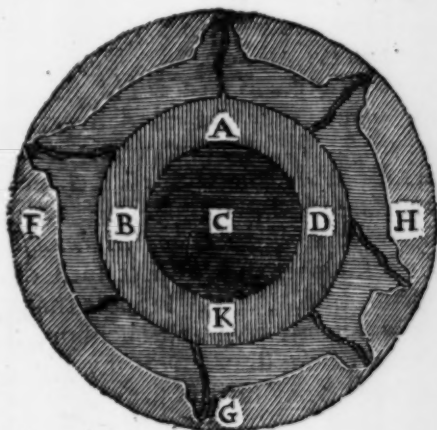
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fixed in the holes to preserve the fluid, which is to be poured afterwards above on the Cylinder from running into the holes, and then let Oil or any other fluid lighter then wood, be poured on as high as the very top of the Vessel; this Oil would indeed press upon the Cylinder, and make it sink deeper into the fluid, which would rise up within the holes till it pressed as strongly upon the surface of the water under it, as the Oil and Cylinder both together doe upon the surface of the water under them. Now in this case, since the water is of a greater intensive gravity than both the Cylinders of Wood and Oil; it is evident, that it is impossible the fluid within the holes can rise so high as the top MN, for then the fluid which lyes immediately under that which is contain'd within the holes and the Tube, suffering a greater pressure than the rest of the fluid under the Cylinder, will immediately descend and force that which is under the Cylinder to ascend. So that tho' the solid Body must in this case sink deeper, yet it is plain, that none of the water within the Vessel can by this means be brought upon the surface.

Let us now apply this to the present  
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purpose, and see what will be the effect. Suppose ABCD a solid Mountainous Crust laid over the Abyfs; and let the orifices of the fissures be supposed to be



only in the Mountains, which we may conceive like so many Tubes rising up from the tops of the Mountains; and afterwards let there be laid upon this Crust any load of water whatsoever, for example to the height of two miles.

Mr. Whiston says, that it is evident, that the pressure of two entire miles over each Column being so prodigiously great, must squeeze the fluid upwards thro' the

*fissures, and thereby throw out the incumbent water, and perhaps it self upon the face of the Earth.* But as evident as he says this matter is, I must sincerely declare, that I cannot see how any such effect can follow from a pressure after this manner. I hope Mr. *Whiston* does not act here like some new Philosophers, who, when they are to deliver some false, dark, or incomprehensible notion, generally usher it in with a speech about clearness and distinctness, and tell us, *That 'tis evident, 'tis plain, 'tis demonstrative.* But rather than suspect such dealing from him, I could suppose that the fault was in my own apprehension, if I had not demonstration on my side, to shew, that from such positions no such effect can follow. Does not he suppose this Crust to be composed of Columns of 200. miles in depth? Did not they subside close by one another, and form a solid Arch upon the Abyss according to him? If so, those fissures and cracks upon the Mountains like so many windows in a Vault, would not much weaken the strength of the Fabrick; but still it would be able to sustain a much greater weight. Would not the water that came from the Comet immediately spread it self equally  
over



over the face of the Crust? And by this every Column would be equally pressed, and therefore one could not sink deeper than another. What is it then that could force the fluid thro' the fissures? However, let us suppose the pressure much stronger upon one place than the rest; if the solid Column upon which this pressure lay, was closely united and cemented to all the other circumambient ones, how could it be broken off from the rest? It is impossible to imagine that the weight of the waters above it could do this. But if it was before separated and disjoyn'd by the Tide on the Abyss, or any other cause, would not the water run down in the fissures which separate it from the rest, and instead of depressing, elevate the loose Crust, as I have already demonstrated?

We cannot well suppose this part which was most pressed, if it was loose from the rest, to be so closely joyn'd to them, as to leave no space for the fluid to descend: For it would be a strange chance that would make the surfaces of the Columns so exactly fitted and adjusted to each other. Besides, if they were so, because the Arch *AB* is greater than *CD*, it is impossible that in such a  
case

case it could descend or be forced downwards. But after all, if it could descend, I have already demonstrated, that none of the water in the Abyfs or Bowels of the Earth, could by that pressure be raised so high as the tops of the Mountains, that it might from thence spread it self upon the surface of the Earth.

If Mr. *Whiston* does not see the evidence of this reasoning, I must leave him to be satisfy'd by his own experiment\*; only instead of a Cylinder of Stone or Marble, I desire him to take one of Wood; and if by pouring Oil upon it, he can raise any water from the bottom to the surface of the Cylinder, I will give over all reasoning upon this subject; but if he finds that his experiment will not succeed, (as it certainly cannot) I hope he will own that he is in an error; and then I doubt not but he will think I had reason to speak peremptorily upon this point, when I said that it was demonstratively evident, that by no sort of pressure of the incumbent fluid, the Abyfs could be forced upwards to spread it self upon the surface of the Earth, which words I do not think fit to retract.

I have already considered the ways Mr. *Whiston* has taken to bring waters upon the Earth, to make a Deluge. Let us next see how dexterous he is in removing them.' In my Remarks on his *New Theory*, by Calculation I shew'd, that there must have been at least twenty three Oceans of water, to drown the Earth at the time of the Deluge. One would think that it were a hard task to remove such a load of waters Mechanically. Yet he tells us, that he thinks there is no manner of difficulty in it.

In his Theory he supposes, that the waters descended thro' the perpendicular fissures and cracks, which were outlets to so great a part of them before; and by that means Saturated all the Pores of the dry Earth, that was capable to contain mighty quantities of water. Now in the Remarks on the *New Theory*, I showed that none of the waters could descend thro' the cracks and fissures of the Earth; for they of necessity must have been all full at the time of the Deluge, since water cannot lye upon the surface of the Earth, till all the cracks, holes, and fissures in it, be first filled. This is so evident both to sense and experience, that it is beyond all contradiction

diction true: it being as impossible to make water lye on the Earth before all its cracks, pitts, and holes are filled, as it is to make a Vessel retain water, whose bottom is bored thro' with many holes.

Instead of answering this Argument, Mr. *Whiston* tells us, That certainly the Pores and Interstices of thirty or forty miles of dry Earth, are capable of receiving three or four miles of water into them, and certainly the same fissures that permitted the ascent of the fluids from beneath before, would after the ceasing of that force, permit the descent of the waters of the Deluge, and by degrees and length of time draw them off.

I find Mr. *Whiston* is generally most certain, where other men are most doubtful. How can he be certain, or so much as suppose, that the waters could lye above the mouths of the cracks and fissures, to the height of two miles perpendicularly, and none of them run in to fill them all the while? What new Laws of Hydro-staticks has he discovered? It is generally supposed to be the nature of a fluid, to descend thro' whatever holes and fissures it can find; and 'till they be once fill'd, it is impossible it should rest above the mouths of those fissures, especially to the height of two per-

perpendicular miles. For so high it must have been above most of those cracks, since most part of the Hills in which he supposes those fissures were, do not exceed above a miles height. Before the water could have risen to such a height, not only the perpendicular holes and fissures, but even the Horizontal ones, must have been absolutely filled.

I cannot therefore enough wonder, how he can imagine so much water forced thro' the Earth upon its surface, and all those cracks and fissures remaining empty all the time: I am surpriz'd to hear him tell us of *dry Earth*, that was capable of receiving vast quantities of water, for I cannot suppose an Earth that has been watered by eleven Oceans of water gushing thro' its Pores, to be very dry. Another man would rather think, that it must have been very wet, for it is not to be imagined, that so much water could pass thro' the Crust without leaving as much of it self as the Crust could hold behind it, since water rather than ascend will remain in any Pore or empty space that can contain it.

But let us now allow, that the Earth or the Crust was as dry as if there had  
not

not one drop of water remained in it; yet the Earth thro' which water generally can sink, is but a few feet in depth; the rest of the Crust is composed of a *tough Clay, common Stone, Whinstone, Coal, Metalline Ores*, and the like; and I believe he can never persuade Mankind, that there are so many Pores in such heavy, close, solid Bodies, as are capable to contain twenty two Oceans of water.

But after all, let us suppose that the fissures were empty, and that they were capable to receive the whole twenty two Oceans of water. Let us suppose that the water lay over them, without descending into them; *that is*, let us grant to Mr. *Whiston* so many impossibilities. Yet even all these suppositions will not answer the *Phænomena* of the draining of the waters from the Earth after the Deluge. This I think I can prove easily, since that according to the Mosaical account of the Deluge, the waters were removed from off the face of the Earth in one half year; whereas if they had been removed by the method of the *New Theory*, they could not have been drained from the Earth in many hundred years. And therefore upon this  
account

account Mr. *Whiston's* suppositions will not answer the *Phænomena*. To shew this, let us suppose the mouths of all the cracks and fissures to have been just equal to the mouths of all the Rivers in the Earth, (tho' if we consider how narrow and small they are in respect of the mouths of the Rivers, we cannot allow them to have been near so much) It was proved in the Examination of Dr. *Burnet's* Theory, that all the waters that run thro' the Rivers would fill the Ocean, if it were empty, in the space of 812. years; and consequently, if at the time of the Deluge, the water descended no faster thro' the fissures, it is evident, that upon the former supposition it would be 812. years, before the Earth had received one Ocean into its Bowels, and therefore it would be 17864. years before twenty two Oceans could be removed thro' those fissures. But let us now suppose that the velocity of the water descending, was ten times greater than the velocity of the Rivers; we shall still find, that the waters would take 1786.4. years to run thro' the fissures. So that altho' Mr. *Whiston* has been pleas'd to ridicule my fondness for Miracles, yet since all the natural causes  
he

he has assign'd, are so vastly disproportionate to the effects produc'd, he may at last perhaps be convinc'd, that the easiest, safest, and indeed the only way is to ascribe 'em to Miracles.

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*FINIS.*

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